SCIENTIFIC AMERICAN

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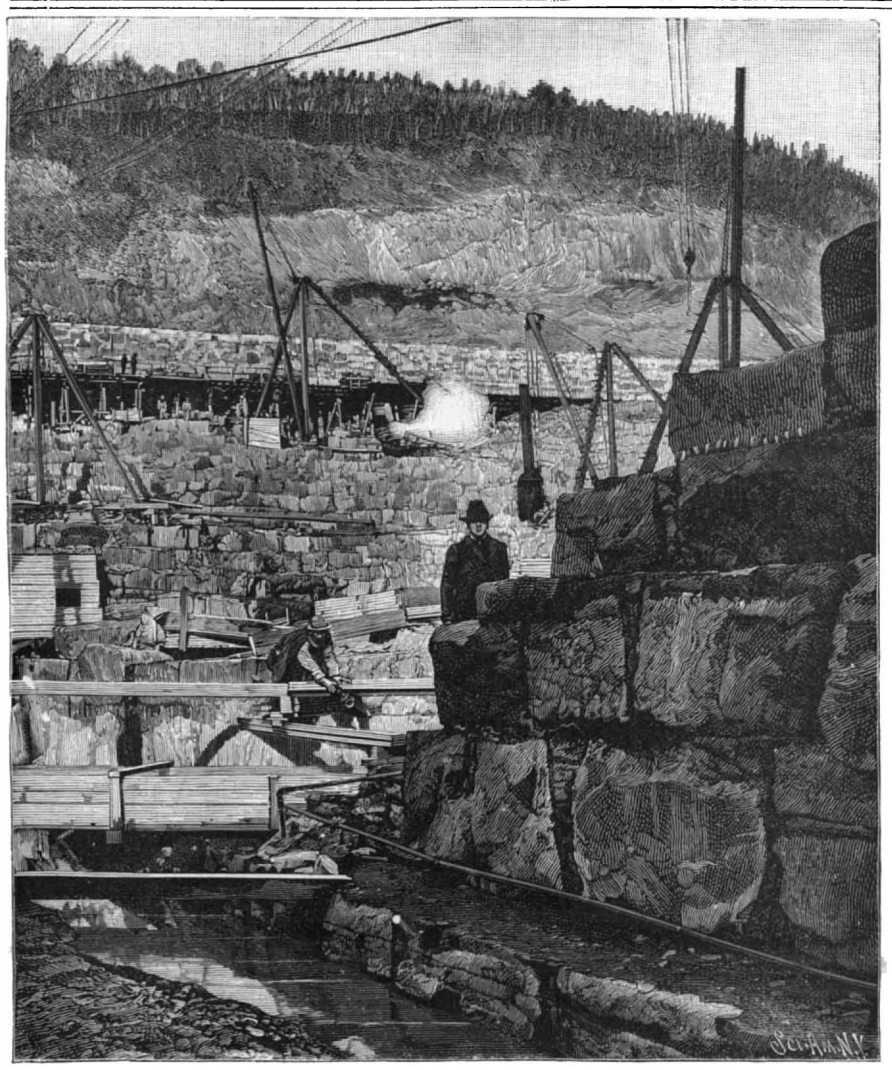
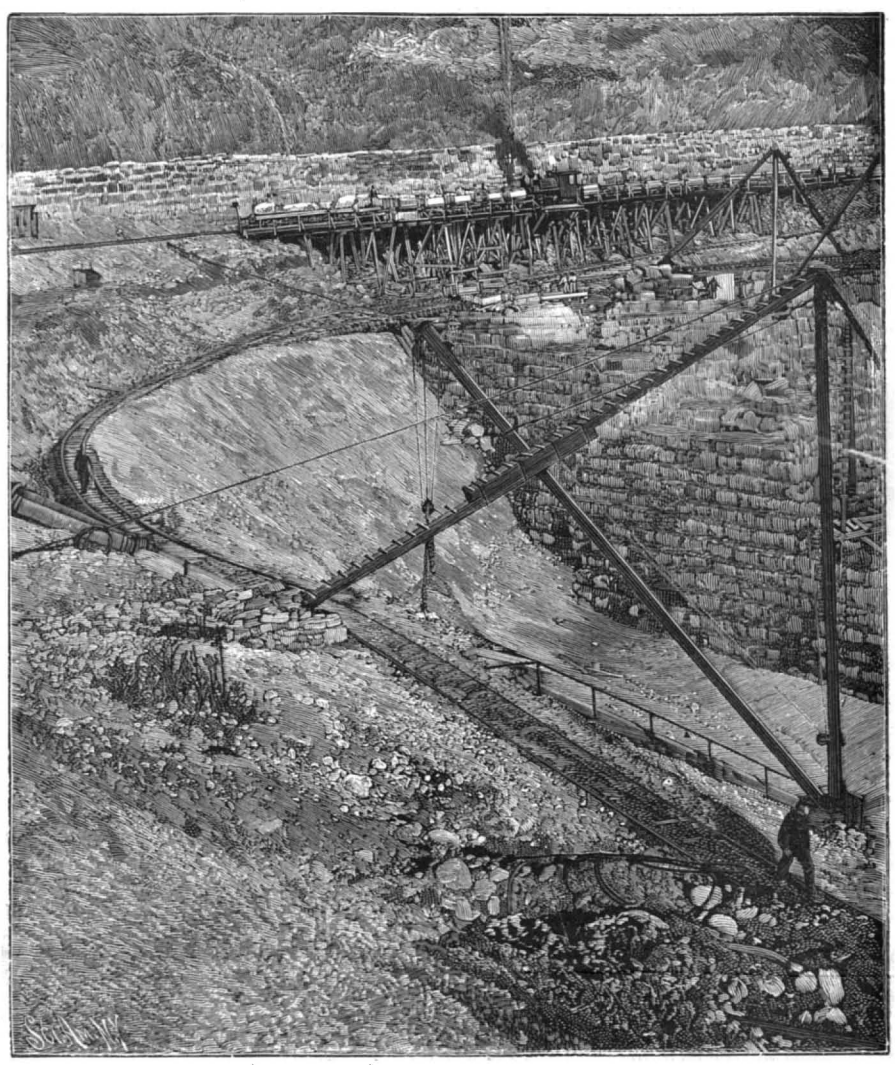
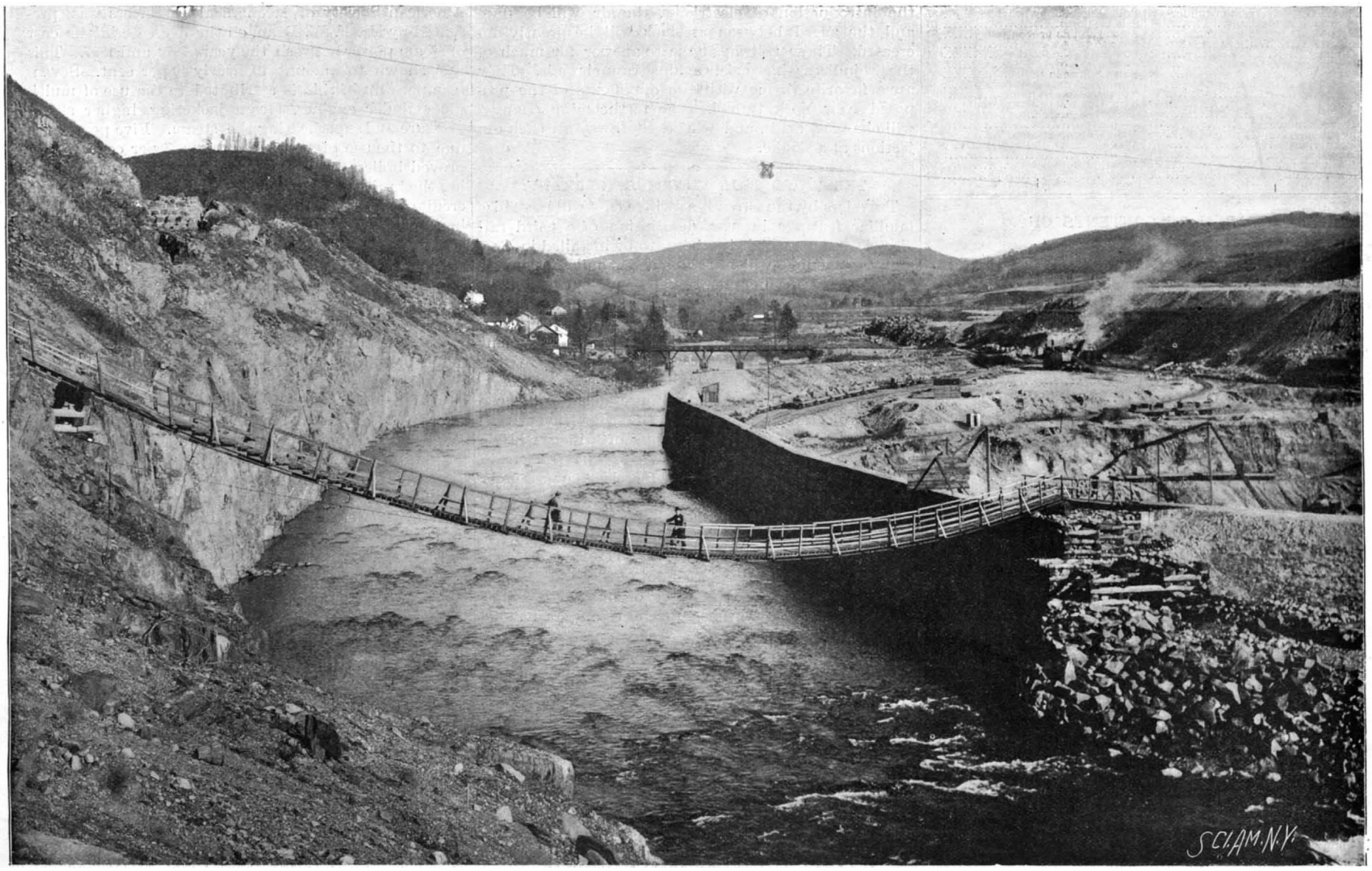


1.—NEAR VIEW OF THE THREE-FOOT COURSES OF MASONRY.



2.—RAILWAY ACROSS END OF DAM, BRINGING ROCK TO OVERHEAD CABLEWAY.



3.—THE ARTIFICIAL CHANNEL AROUND NORTH END OF DAM.

NEW YORK CITY WATER SUPPLY—NEW CROTON DAM.—[See page 88.]

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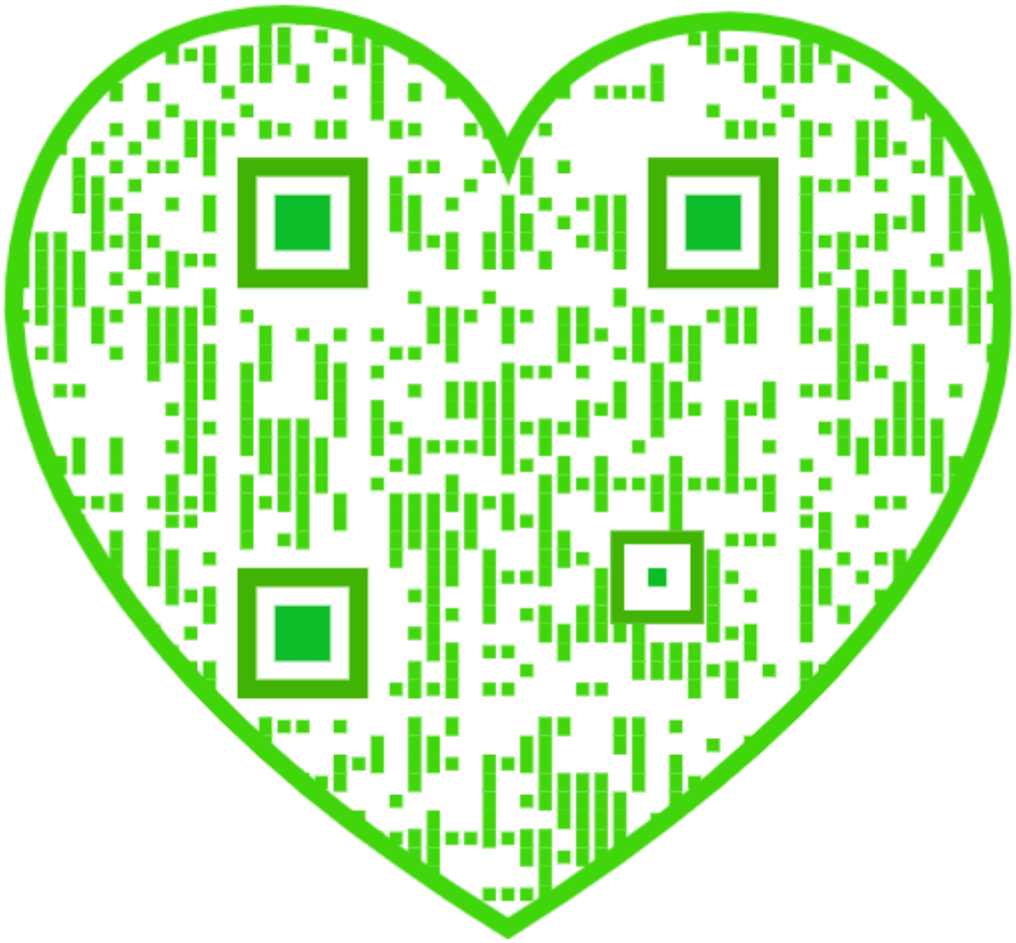

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STRIKING SUCCESS OF THE TIN-PLATE INDUSTRY IN THE UNITED STATES.

There is, perhaps, no industry in the history of the United States which has enjoyed such a rapid and uninterrupted growth as the manufacture of tin-plate. Each year has shown an increase over its predecessor in the number of mills in operation and in the total output, and the most gratifying feature of all is that the price of the tin-plate to the retail dealer has steadily declined since the year when its manufacture in this country was first fairly started. The statistics furnished by Special Agent of the Treasury Ayer place the output of tin and terne plate at 446,982,063 pounds for the last fiscal year as against 307,226,621 pounds for the year preceding, an increase of over 45 per cent. It should be noted, too, that the report embraces the production of fifty firms, or three less than that for the fiscal year ended June 30, 1896.

Of these fifty firms, only one used foreign-made plates during a portion of one quarter, the amount being 57,208 pounds out of a total production by the firm for that quarter of 213,687 pounds. Compare this with the report of the previous year, when, of fifty-three firms reported as producing tin and terne plates, three used both American and foreign rolled sheets, with an aggregate output of 15,503,523 pounds, of which 4,226,523 pounds, or 27 per cent, was made from foreign rolled sheets. The total amount of tin and terne plate imported was 244,407,601 pounds. The quantity of plate imported and used in the manufacture of articles for export was 139,246,130 pounds. This leaves a net import of 105,161,471 pounds as against a total domestic production of 446,982,063 pounds. We thus arrive at a total approximate consumption in the United States of 552,143,534 pounds.

ELECTRICITY TO REPLACE STEAM ON THE LONDON UNDERGROUND RAILWAYS.

At last, after nearly half a century of discomfort due to steam and gases from the locomotives, the two famous underground railways of London, known familiarly as the "Metropolitan" and the "District," are about to banish the steam locomotive altogether. It has been decided to use electric traction; and it is likely that the third rail system will be employed. Only those who have had the misfortune to travel on these lines can appreciate what a relief the proposed change will afford to the general London public and to the City business man in particular. Apart from the vitiated atmosphere there was nothing to complain of in these railways. The service was prompt and frequent, and on account of the side doors, one at each pair of seats, discharging directly on to the platform, trains were emptied more rapidly and stops were briefer than on our own elevated lines, where the passengers have only two means of exit from the car. With the introduction of electricity, the air will be pure and the speed between stations will be greatly increased. These railways have to answer for much of the prejudices which exists against tunnel roads. They are a favorite theme with the opponents of the proposed New York tunnel. The forthcoming changes will change all this, and will sweep away all such objections at a stroke.

THE THIRD RAIL SYSTEM IN GERMANY.

Travelers by the Brooklyn Bridge cars will recognize familiar features in the description of a third rail electric system which is about to be installed in Germany. The line, which is about 7½ miles in length, runs between Berlin and Zechlendorf. The conductor will consist of a third rail carried at the side of the track on wooden saddles which will themselves be bolted to the ends of the ties. The present brake equipment will be utilized, and power will be supplied by compressors driven by electric motors carried on the cars. A similar brake equipment is at present in use on the Hartford-Berlin electric line of the New Haven Railroad in this country, illustrations of which will be found in our issue of June 12, 1897. The trial train will be unprecedentedly heavy for electric passenger traction, the loaded weight being 210 tons. The service will call for fifteen round trips per day.

SMOKE AND ITS PREVENTION.

Experiments recently carried out at Sibley College to determine the physical features of smoke show that dense smoke from a furnace produces on an average from 10 to 12 pounds of soot to the ton of fuel used. About one-half of the former was carbon, and the remainder was chiefly made up of unburnt hydrocarbons, from 10 to 15 per cent of ash and 2 per cent of moisture. The figures just stated were obtained with a restricted air supply. Low temperature combustion and a restricted supply of oxygen are the most fruitful causes of smoke production. In this connection we are reminded of a trip which we once took on the foot plate of an engine which was hauling the fast mail train that takes the American mail from Queenstown to Dublin. The furnace door was of the divided pattern, the two halves sliding apart sideways and being operated by a single lever. We noticed that when the fireman was shoveling coal into the furnace, the engineer by means of the lever opened the doors for each shovelful and instead of shutting them abruptly drew them slowly together. He explained that he was "burning the smoke," and illustrated the fact by shutting the door quickly after a shovelful was thrown in, when dense volumes of smoke appeared at the smoke stack. This was an extreme case; but it serves to indicate the careful firing to which, no doubt, is due in large measure the economy of the British express locomotives, which burn only from 22 to 35 pounds of coal per mile according to the load hauled.

SPRAGUE MOTOR PATENT DECISION.

An important decision affecting the Sprague patent for a suspended railway motor has been given by Judge Wheeler, in the United States Circuit Court. It is well known that in the earlier attempts at electric traction the motors were either carried upon the car platforms or rigidly attached to the wheel trucks, connection with the driving axle being made by chain and sprocket or by friction wheels. The effect of this construction, both upon the motors and the track, was very destructive.

Frank J. Sprague patented a method of suspending the motors so that both they and the track would be relieved from shock and yet the motor would be always maintained in its proper relation to the axle. This was done by suspending one end of the field magnet of the motor on the axle and supporting the other end on springs, thereby causing the latter to move with a radial play around the driving wheel axle and permitting the use of gear wheels. The device marked the opening of a new era in railway motors, and opened the way for the successful application of electric traction.

The Sprague Company was absorbed by the Edison Electric Company, and the latter was eventually absorbed by the General Electric Company. The present suit was brought by the General Electric against the Union Railway Company and the Walker Company, of Cleveland, on the ground that the latter were infringing upon the Sprague patent, and the present decision of Judge Wheeler sustains the plaintiff.

Commenting upon the decision, the Walker Company, who intend to carry the case to the Circuit Court of Appeals, state that they expect the patent to be overthrown, and believe that the use of the invention will be thrown open to the world.

The decision states that "the defendants' structures differed in some respect from those of the patent, but have all these parts" specified in the decision "working together in the same relation to each other for the same purpose and producing the same result."

COST OF STEAM IN 1870 AND 1897.

One of the best papers recently read before the American Society of Mechanical Engineers was presented by Mr. F. W. Dean, on the decrease in the cost of steam power between the years 1870 and 1897. This was shown to amount to nearly 40 per cent. Seventeen per cent of this is attributed to the use of multiple cylinder engines, steam jacketing, higher steam pressure and superheating the steam. Five per cent is due to the use of vertical engines, 7 per cent to improved boilers, 7 per cent to economy realized in heating the feed water, and 2 per cent is put down to the credit of improved construction of grates. Taking the best performances of the two periods named, the least consumption of steam per horse power per hour in 1870 was 20 pounds, whereas the best for 1897 was 12½ pounds.

EXCELLENT CONDITION OF THE IRON AND STEEL EXPORT TRADE.

The present condition of the iron and steel export trade is very satisfying and full of promise. If the figures for the first ten months of the year are a criterion, the total exports for the year 1897 will amount to some 600,000 tons, valued at about $13,000,000. The largest item was pig iron, of which we shipped in the first ten months 194,734 tons; the next was steel rails, 108,816 tons. The other most important exports in their order were steel ingots, billets, bars, etc., 59,633 tons; wire, 44,016 tons; scrap and old iron for remanufacture, 34,929 tons; and cut nails and spikes, 13,165 tons. Our steel rails and locomotives are being sold in Europe in successful competition with the local manufacturers, and in view of this fact it is needless to add that we are gathering in an increasing share of the foreign trade of the world, which was formerly exclusively controlled by Europe.

THE TURBINE FOR UNITED STATES TORPEDO BOATS.

We are pleased to note that the United States is not to be behindhand in the development of the steam turbine for naval purposes. The truly astonishing results obtained with the Turbinia have a significance which cannot be gainsaid. We do not predict that the turbine will revolutionize marine propulsion in general, but we are satisfied that for vessels up to a size yet to be determined, it is the coming motor. Commodore Melville, Engineer-in-Chief of the Navy, is about to make tests of an American design of turbine in the

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propulsion of torpedo boats which is said to be free from the somewhat serious defect of the Parsons turbine. The latter can only run in the forward direction, and it has been necessary to install a separate motor to drive the ship astern, an obviously uneconomical arrangement. The new motor has a further advantage in its moderate speed—about 600 revolutions against 2,000 in the Parsons machine.

PETROLEUM FUEL.

It is also gratifying to learn that the experiments which the Bureau of Steam Engineering is carrying out in the Stiletto in the use of liquid fuel are meeting with complete success. The great advantages of liquid fuel are that it may be run into the bunkers or tanks by gravity, thus doing away with the tedious and costly loading by hand. It can be brought into the furnaces without handling, thus reducing the number of stokers, and it produces no ashes. A ton of oil, moreover, contains about twice as much heating power as a ton of coal, and hence the amount of fuel supply may be doubled without adding to the weight of the vessel. With a combination of liquid fuel and the turbine in the same vessel we may look for some great developments in the present government experiments.

A THIRD EAST RIVER SUSPENSION BRIDGE.

The new commissioner of bridges of New York strongly advocates the erection of another bridge across the East River. It is proposed to build a great suspension bridge which shall be used exclusively by the various railroad systems, both street and elevated. The site would be chosen with strict regard to the location of the various lines of railroad, so as to serve as a connecting line which would intersect them at the most convenient points.

The proposal is largely the outcome of the recent agitation for running elevated and surface roads across the existing New York and Brooklyn Bridge, and it is urged that the building of such a bridge is the only satisfactory solution of the railway traffic problem. More than one site has been suggested; but the two most favored lie between the present bridge and the new bridge now building about a mile further up the river, and just below the present bridge on a line between the New York and Brooklyn post offices.

GOVERNMENT TESTS OF TIMBER.

It is surprising that in these days, when the strength of all structural material is carefully determined, we should possess such imperfect knowledge of the strength of the various woods which are used in construction and manufacture. There is lacking to-day a thoroughly reliable table of the strength of woods. We say this with the full knowledge that all the text books and engineers' and mechanics' pocket books give such tables; but unfortunately the data upon which they are founded is not of that comprehensive or scientific kind which alone can give such tables their proper value. Most of the investigations of the strength of timber already made have been carried out by individuals who had neither the time nor the means to do the work as thoroughly as it should be done. The first investigation of the subject on an adequate scale is now being carried out by Dr. B. E. Fernow, of the Forestry Division of the Department of Agriculture. To examine and test a sufficient number of specimens of any given species is a costly undertaking; but the department has shown good judgment in preferring to expend its appropriations in doing thorough work on a limited number of species rather than in doing more or less superficial work upon a larger variety.

During the past year, owing to the failure of government to provide funds for carrying on this work, Dr. Fernow rented a testing machine with which to carry on his investigations. In the course of his work he made the important discovery that a constant mathematical relation exists between the compressive and the tensile tests of any species of timber, and that henceforth it will be sufficient to make a laboratory compressive test, the tensile strength being calculable from the data so obtained. Dr. Fernow gives the credit for this important discovery to Mr. S. F. Neely, one of his assistants. It is needless to say that the cost of completing the investigation of American woods will be greatly reduced, and it is to be hoped that Congress, encouraged by this fact, will grant the appropriations asked for the coming year's work.

JAPANESE CRUISER LAUNCHED AT CRAMPS' YARD.

Special importance attaches to the launch of the Japanese cruiser "Kasagi," at the Cramps' yard, Philadelphia, which took place on January 20. This is the first warship of the modern type to be built in this country for a foreign power, and if this should prove to be the forerunner of other foreign orders to follow, an important industry will be opened up which will go far to remove the stagnation which has settled upon many of our shipbuilding yards. At the time when the "Kasagi" was ordered a contract was made for a sister ship to be built at the Union Iron Works, San Francisco. This vessel was illustrated in the SCIENTIFIC AMERICAN for July 3, 1897, and its launch will take place at an early date. The high character of the work which is being put into these vessels will speak for itself and establish our reputation with the various governments which purchase their warships abroad. The "Kasagi" is modeled on the lines of the fast and powerfully armed protected cruisers which have been built by Armstrong, of England, for the Japanese and other foreign navies. She is 396 feet long, with 49 feet of beam and a draught of 17 feet 9 inches, her displacement at this draught being 4,900 tons. She is to show a speed of 22½ knots. Her horse power is 17,000, and she will carry enough coal to cruise for 4,000 miles at 10 knots an hour. Her armament will be supplied from England, and will consist of two Armstrong 8-inch and ten Armstrong 4·7-inch rapid-fire guns. She will rely upon a protective deck and her coal bunkers for protection, the former being 1¾ inches thick on the flat portion and 4½ inches thick on the slope. The 8-inch rapid-fire guns have a speed of fire three times that of the old slow-firing type, so that these two guns alone would equal the six 8-inch guns carried on our own "New York," a ship of 8,000 tons displacement. As the energy of each shell from the "New York's" 8-inch guns is 7,498 foot-tons and that of the shells from the "Kasagi's" 8-inch guns is 10,662 foot-tons, we see what an enormous advantage is gained by the adoption of the rapid-fire system. In the present instance it brings the offensive power of a 4,900-ton ship up to and beyond that of an 8,000-ton ship. This comparison is an important commentary upon the urgent plea of Assistant Secretary of the Navy Roosevelt for the arming of our cruisers with guns of the rapid-fire type.

ANNUAL SESSION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The forty-fifth annual meeting of the American Society of Civil Engineers was begun in the new house of the society under the presidency of Benjamin H. Harrod. The membership of the society was announced as 2,079, the number of non-residents being 1,604. It was announced that the Norman medal had been awarded to Julius Baier for his paper on "Wind Pressures in the St. Louis Tornado, with Special Reference to the Necessity of Wind Bracing for High Buildings," and that the Thomas Fitch Rowland prize had been awarded to Arthur L. Adams for a paper on "The Astoria City Waterworks." No award was made of the Collingwood prize for juniors.

It was moved that a special committee be appointed to examine into the question of paints used on structural work, and that another committee be appointed to consider the subject of rail joints for standard steam railroads. W. W. Crehore offered a resolution that the society "hereby record its disapprobation of the Department of Public Parks" of New York in employing a firm of architects to design the new bridge across the Harlem River at Lenox Avenue, "and protest against the selection by public officials of a person or persons outside the engineering profession to design and prepare plans for a distinctly engineering work of such importance and magnitude."

The result of the annual election of officers was as follows: President, Alphonse Fteley, New York; vice presidents, E. P. North, New York, and Frederick P. Stearns, Boston; treasurer, John Thompson, New York. The members of the society, after the installation of the new president, formed into three parties, one of which visited the Jerome Park reservoir, another the Bowling Green building, and a third went to Columbia University and inspected the new buildings.

COMMERCE ON THE GREAT LAKES.

The lake navigation season just closed was one of the most active on record, and the statistics now published, says The Pittsburg Dispatch, give their own evidence of the restoration of prosperity. The first part of the season business was lighter than usual, but the deficiency was more than compensated for in the later months. A total of 18,218,400 tons passed through the canals at Sault Ste. Marie during the year, an increase of over 2,000,000 over the shipments of 1896.

A notable feature of this business is that it was carried by fewer vessels than were in service the year before, the modern carriers being of much greater capacity than those of a few years ago. The deepening of the channel and the completion of the new American lock permitted the new vessels to load all they could carry. This year the navigators believe the lake trade will be larger than ever, and they are preparing to carry it with fewer ships than they had in service in 1897.

So much has been said of the magnitude of this internal commerce, compared with the seagoing trade of this and other countries, that every one is familar with it. But for Pittsburg the fact has a peculiar interest. To no other point does as large a proportion of the total tonnage go as goes there, and at no point does a larger proportion start than in the Pittsburg region.

THE HEAVENS IN FEBRUARY.

BY GARRETT P. SERVISS.

The Milky Way has become an object of increased interest since Barnard made his exquisite photographs of its star clouds and star gaps, and every observer of the heavens should note its position and appearance from month to month. At 9 P. M. in the middle of February it forms an arch completely spanning the heavens and passing not far from the zenith. Rising from the horizon in the north-northwest it passes just east of Sirius, which is then near the meridian, and between the head of Orion and Gemini, the latter being nearly overhead in our latitudes. Then it traverses Auriga, to the north of Taurus, and descends through Perseus and Cassiopeia, leaving Andromeda on the west, until it disappears behind the hills in the south-southwest. At the same hour the Great Dipper is seen rising in the northeast with its handle pointing downward.

THE PLANETS.

Mercury is a morning star, and can be seen before sunrise in the first part of the month. It is in the constellation Sagittarius at the beginning of the month, but at the end it will have passed across Capricornus into Aquarius. A close conjunction of Mercury and Mars will occur on the 11th. The two planets will be only one minute of arc, or less than one-thirtieth of the moon's diameter, apart. Unfortunately, their closest approach will occur at 1 o'clock P. M., eastern standard time, but they will be near enough together just before sunrise of the same day to present an interesting sight if the eastern horizon is clear.

Venus is also a morning star during the first half of the month, but too near the sun to be well seen. She is in Capricornus at the beginning of the month and in Aquarius at the end. She passes behind the sun (superior conjunction) on the afternoon of the 15th and then becomes an evening star, but still too near the solar orb to be seen.

Mars is likewise in the morning sky, very near the sun. He passes from Sagittarius into Capricornus about the 12th.

Jupiter is gradually coming into a better position for observation. He is in Virgo, not far from the double star Gamma, and rises about 10 P. M. at the beginning of the month and about 8 P. M. at the close.

Several interesting phenomena arising from the motions of Jupiter's satellites occur on the night of the 12th at fairly convenient hours for observation. At about 10:19 P. M. the shadow of Satellite II will be seen passing upon the planet's disk. The transit of the satellite itself across the disk will begin at 12:10 A. M. In the meantime, at 11:08 P. M., Satellite III will come out from behind Jupiter, or reappear from occultation. At 12:55 A. M. the shadow of Satellite II will pass off the face of the planet, and at 1 o'clock 2 minutes and 46 seconds A. M. Satellite I will be eclipsed by passing into Jupiter's shadow.

On the night of the 13th Satellite I, preceded by its shadow, may be watched passing across Jupiter between the hours of 10:12 P. M. and 1:18 A. M.

The observation of Jupiter's satellites requires the use of a telescope, but a good 3½ or 4 inch glass will amply suffice. The time given is Eastern standard.

Saturn is in the constellation Scorpio, very close to the border of Ophiuchus, and will pass into the latter in the course of the month. It is a few degrees northeast of the red first magnitude star Antares. It rises on the 1st shortly before 3 A. M., and at the close of the month about 1 A. M.

Uranus is also in Scorpio, about a degree east of the pair of little stars called the Omegas, just below the well known double Beta Scorpii.

February both opens and closes with a waxing moon. The first moon fulls on the 6th and reaches last quarter on the 13th. The new moon of the month occurs on the 20th, reaching first quarter on the 28th.

The moon will be in perigee, or nearest to the earth, early on the morning of the 17th, and in apogee at midnight on the 28th. The greatest libration east occurs about midnight on the 8th and the greatest libration west about 11 P. M. on the 22d. It is owing to the libration of the moon that we are able to see a portion of that lunar hemisphere which is perpetually turned from the earth. We look first a little around one side and then a little around the other side.

A STUDY of ozone from a technical standpoint, by E. Andreoli, appears in The Journal of the Society of Chemical Industry. Theoretically, one should be able to produce a kilo of ozone per electric horse power, but in practice only 10 or 12 grammes are obtained. By improvements in the apparatus for producing ozone, the author increases the production to thirty and even fifty grammes per horse power, making the cost about 75 cents a kilo. The author proposes practical applications of ozone, such as purification of drinking water, cleansing of beer casks, preparation of wood for instruments and furniture, bleaching of starch and dextrin, oxidation of drying oils, purification of wine and brandy, etc. It does not appear, however, that any of these proposed uses have been tested practically and on a large scale.

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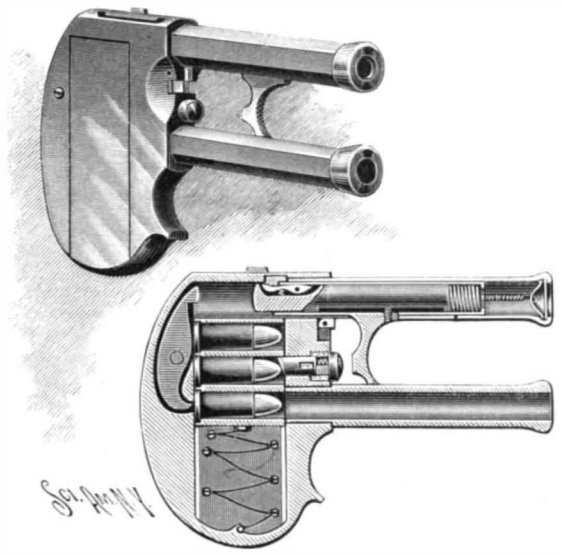
A NOVEL REPEATING PISTOL.

A pistol especially designed to be conveniently carried in the pocket by bicyclists and others wearing somewhat closely fitting garments, and which may be held more steadily than the ordinary pistol when firing, is represented in the accompanying illustration and has been patented by August Nygren, of Elizabeth, Minn. According to this improvement, the extreme length of a 32 caliber weapon is designed to be 4¾ inches, of which the barrel measures 4¼ inches from the rim of the cartridge, the depth being 3¼ inches and the thickness at the thickest part $\frac{9}{16}$ inch. The ball is ejected from the lower one of the two barrels, the other carrying the bolt mechanism and the trigger being located between the two barrels, the feed device presenting a cartridge each time that the trigger is pulled and released. As shown in the sectional view, both barrels are in communication with a chamber in the grip or handle section, a cartridge block sliding on ribs in this chamber having separate partitions to accommodate three or more cartridges and a spring normally tending to draw the cartridge block downward. The trigger is attached to the bottom side of a cylindrical jacket sliding in the upper barrel, and in this jacket slides the firing bolt, against the front end of which bears a spiral spring, while a spring of less strength connects the front end of the bolt with a loop or keeper extending across the front end of the upper barrel. In a recess near the heel of the firing bolt is pivoted a spring-

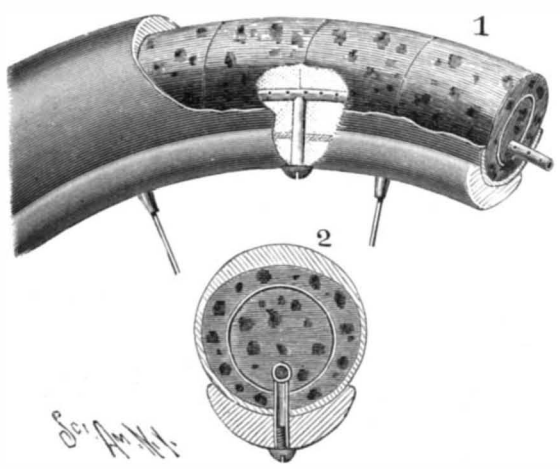


NYGREN'S MAGAZINE PISTOL.

pressed pawl, normally locking the firing bolt from backward movement, but with the forcing backward of the cylindrical jacket by pulling on the trigger, the pawl is released, when the compressed spiral spring drives the firing bolt violently into contact with the head of a pivoted firing pin in the rear of the magazine chamber, causing the firing point of the pin to suddenly strike the cap of the cartridge in the lower chamber of the cartridge block. After firing, the jacket and firing bolt are drawn back to normal position by the spring extending to the front end of the upper barrel. A safety catch is provided, by the use of which the trigger may be locked against movement when the weapon is not likely to be used.

A PUNCTURE-PROOF TIRE.

A tire which is puncture-proof, and designed to possess the resiliency, elasticity and other desirable qualities of a pneumatic tire, without any of its disadvantages, is represented in the accompanying illustration, and has been patented by Franz A. Hamp, of No. 210 East Pearl Street, Cincinnati, O. Fig. 1 is a view in perspective of a portion of the rim and of the tire, the



HAMP'S PUNCTURE-PROOF TIRE.

outer covering of the latter being partly broken away, while Fig. 2 shows a cross section of the tire and rim. The body of the tire consists of a suitable number of cork sections, nearly cylindrical in shape, glued or cemented together, inclosed by rubber tubing, the latter of greatly increased thickness on the tread portion. It is provided that the cork sections may, if desired, be made concave, or straight, or angular, on their tread portion, and thus allow for a corresponding enlargement and fitting of the tread portion of the rubber covering thereon. Each cork section of the tire has a tubular opening, which, when the sections are connected together, constitutes a continuous tubular channel, in portions of which, preferably at opposite inner faces of the tire, are introduced perforated tubes of aluminum or other metal, as shown in Fig. 1, each tube being connected with a branch tube extending through the rim of the wheel. The outer ends of the branch tubes are closed by screws, which serve also to hold the tire to an engagement with the rim, and it is designed to introduce through these tubes, to the interior of the tire, a fluid consisting of amyl alcohol, margaric acid and glycerine, to keep the cork elastic and moist, and preserve the rubber and prevent it from cracking or becoming hard. Rings are also pressed into each end of each cork section, to protect the tire against extraordinary pressure, and these rings are preferably connected together with a rod or other device. It will be seen that, no matter to what degree the outer covering of the tire may be damaged, it will still be serviceable.

Nativity of Pullman Wage Earners.

An interesting table has been compiled by Duane Doty, civil engineer of the company, showing the nativity and the length of service of the 4,803 wage earners at Pullman. It is as follows, says The Industrial World :

Where born.	Number.	Number of each type.
American—		
United States	1,491	1,491
Scandinavian—		
Denmark	63	
Finland	6	
Norway	90	
Sweden	962	1,121
German—		
Austria	62	
Bohemia	17	
Other German states	552	631
British—		
Canada	214	
England	290	
Scotland	90	
Wales	23	617
Dutch—		
Holland	518	518
Irish—		
Ireland	182	182
Latin—		
Belgium	4	
France	5	
Italy	96	
Switzerland	17	122
All others—		
Hungary	19	
Poland	85	
Russia	13	
Other countries	4	121
Totals	4,803	4,803

Number of wage earners who have been dwellers at Pullman :

Seventeen years		52
Sixteen	"	200
Fifteen	"	170
Fourteen	"	219
Thirteen	"	202
Twelve	"	250
Eleven	"	171
Ten	"	324
Nine	"	277
Eight	"	270
Seven	"	341
Six	"	378
Five	"	381
Four	"	310
Three	"	340
Two	"	416
One	"	502
		4,803

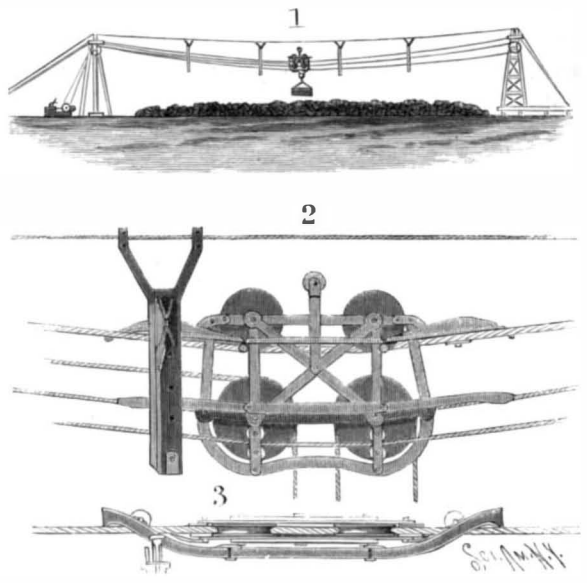
Whole number of males	4,575
Whole number of females	228
Number owning their homes	958
Number not living or boarding in Pullman	2,024

Or 42 per cent of the whole number.

The average length of time these operatives have lived here or in this immediate neighborhood is seven and a half years.

A CABLEWAY CARRIER AND CARRIAGE.

The illustration represents an aerial hoisting and transportation apparatus by which the hoisting rope and endless carriage rope are properly supported and the carriage is automatically switched past the carriers. The invention has been patented by Carl E. Richson, of Brooklyn, N. Y., and is being introduced by Gus. Pers. Wern, M.E., of the De la Vergne Refrigerating Machine Company, foot of East 138th Street, New York City. A fixed rope or cable suspended across the space between towers or elevated points, as shown in Fig. 1, carries a series of hangers which support a main cable forming a track for the carriage from which the load is suspended, the hangers having means to engage the cable and pulleys to support the hoisting rope and the endless carriage rope, and there being means for switching the carriage past the hangers and returning the cable and the ropes to the hangers after the carriage has passed. On the cable below the one supporting the hangers travel pulleys journaled in the frame of the carriage, the latter being connected, as usual, with an endless rope passing over pulleys on the towers, to wind on a suitable windlass, for moving the carriage backward and forward, there being also in the frame of the carriage pulleys over which pass a hoisting rope connected with suitable mechanism for raising and lowering the load. Fig. 2 represents an enlarged side view of the carriage and one of the hangers, Fig. 3 being a plan view. To allow the carriage to pass the hangers, the

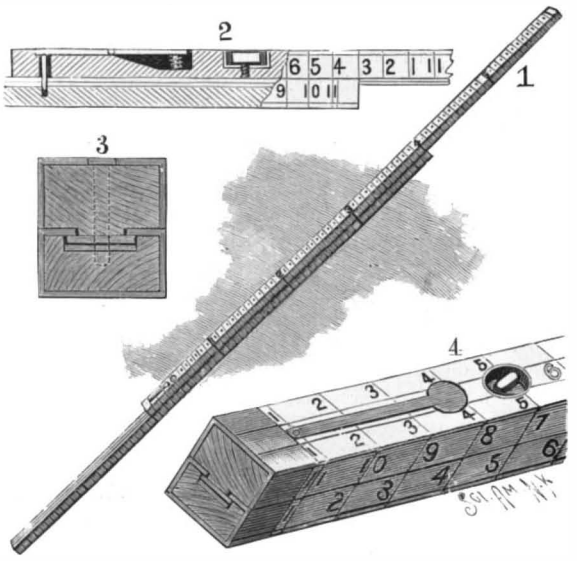


RICHSON'S SUSPENSION CABLEWAY CARRIER AND CARRIAGE.

carriage frame is provided with a sectional track, pivoted end sections of which are arranged to swing up and down relatively to a fixed central section, the end sections being also curved to swing over to the other side of the cable, as indicated in Fig. 3, there being on the outer ends of these sections pulleys adapted to travel on the cable, springs pressing on the hinged end sections to hold the pulleys in engagement with the cable. On each of the hangers is a transverse lever carrying at its free end a wheel extended from the inner face of the support to engage the track on the carriage at either of its end sections, according to the direction in which the carriage is traveling, the arrangement being such that the carriage and hanger will be moved laterally apart as the carriage passes the hanger, the cable and ropes being lifted off their pulleys for this purpose and again returned to them after the carriage has passed the hanger. In this manner the hoisting rope and the carriage rope are suitably supported at intervals on the hangers, so that none of the rope is slack.

AN EXTENSIBLE MEASURING POLE.

A pole for making lineal measures, and which may be readily extended in length, being without projecting parts and composed of sections adapted to slide on



HEGARTY'S MEASURING POLE.

each other, is shown in the accompanying illustration, and has been patented by Reuben Hegarty, of Madera, Pa. Fig. 1 shows the complete pole, partially extended, Figs. 2 and 3 representing lengthwise and transverse sections and Fig. 4 a view of one end. The two members of the pole are held together against lateral play, but capable of lengthwise movement, by means of a flanged rib on one member fitting in a correspondingly flanged groove in the other member. To hold the members rigid with relation to each other, a spring-pressed detent in one member carries at its outer end a pin adapted to enter one of a series of openings in the meeting face of the other member, as shown in Fig. 2, while to hold the members adjusted at any other point a thumb-screw located in one member is adapted to be brought to a wedging engagement with the other member, both the thumb-screw and the detent lying entirely within their respective recesses, so that there are no projecting parts.

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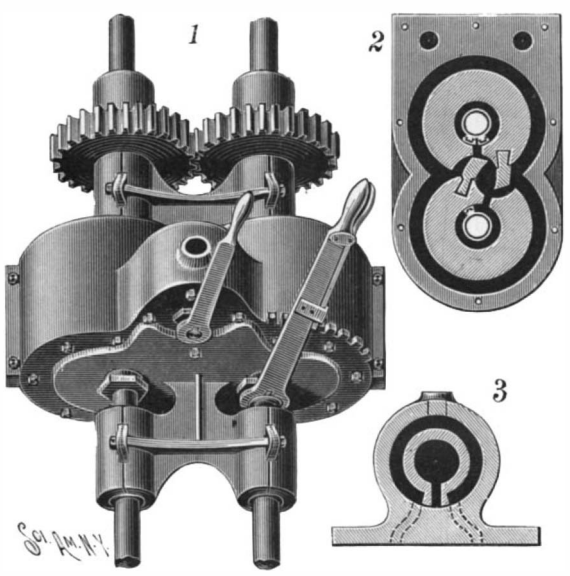
Action of Cathode Rays.

Goldstein was the first to discover that common salt is colored brown and potassium chloride violet by the action of the cathode rays, says The Engineering and Mining Journal. The discoverer attributed this phenomenon to some physical change undergone by the salts. Wiedemann and Schmidt attributed it to their partial conversion into subchloride, and Giesel actually succeeded in preparing similarly colored subchlorides in a chemical way. But the chemical hypothesis is now invalidated by the researches of R. Abegg. He obtained the salts in question in a pure and finely powdered state, so as to be able to color them all through. His first experiments showed that the coloring does not spoil the vacuum in the tube, as it would if chlorine were evolved. The salts were rendered colorless again by high exhaustion, producing rays with a strong heating effect. The substances could be colored and uncolored any number of times in succession. When the colored salt was dissolved it produced no reducing or alkaline reaction. When undissolved in a saturated solution it retained its color. All this tells against a chemical change. Moreover, an easily reduced chloride is not reduced by the cathode rays. It is well to remember that the coloration of these alkaline salts is a phenomenon not produced by light. On the other hand, cuprous chloride is blackened by light, but not acted upon by the cathode rays.

AN IMPROVED ROTARY ENGINE.

In the engine shown in the illustration all the movements are rotary, enabling the engine to be run at very high speed, as high as 8,000 to 10,000 revolutions per minute being claimed for it. It is fitted with valve gears adjustable to cut off the steam as desired, thus enabling the steam to be used expansively, and the valves are arranged to take up their own wear and always remain perfectly tight. The invention has been patented by Carl Engberg, of St. Joseph, Mich. Fig. 1 represents the engine in perspective, Fig. 2 being a sectional view of the cylinders and pistons and Fig. 3 a section of the steam chest and inlet valve. The shafts on which the pistons are secured are connected with each other by gear wheels, one of which is adjustable to bring the pistons in proper relation to each other, at the same time permitting the rotary motion of one shaft to be transmitted to the other, and in the body of each piston is dovetailed a piston head, the piston heads being adapted to pass each other in recesses formed in the pistons. The ends of the pistons, as well as their outer faces and the cylindrical heads adjacent



ENGBERG'S ROTARY ENGINE.

thereto, are fitted with suitable packing to prevent leakage and take up wear. The recesses at either side of the piston heads are connected by ports with annular recesses in the pistons, surrounding the shaft, and into each of these recesses extends a sleeve whose outer end is adapted to receive a hand lever adapted to be locked to a notched segment, whereby the steam may be cut off at different points of the revolution of the piston. The annular recesses are also connected with ports leading to the steam chest, the inlet valve controlling which may be readily adjusted to reverse the engine. The engine is perfectly balanced, so that it can be run at a high speed without the least vibration, being thus especially valuable for running dynamos, and is very light for the power it is designed to develop.

PHOSPHORUS may be prepared in the electric furnace from calcium phosphate. A mixture of this salt with carbon and sand or alumina is heated in an atmosphere of some gas neutral to phosphorus, such as coal gas, and the phosphorus which distills over is collected under water. According to Mr. Readman, 86 per cent of the phosphorus contained in the original mixture is obtained, and the product is found to be very pure.—Stahl und Eisen.

THE PLANET VENUS.

Of the planets, Venus is the one that approaches nearest to the earth; and her dimensions are almost the same as those of the latter. Nearer to the sun than we are, she effects her revolution around it in 224½ days; but her distance from the earth greatly varies. As her distance from the sun is about two-thirds of the radius of the terrestrial orbit, it will be seen that when she is in inferior conjunction, that is to say, between us and the sun, her distance from the earth is only a third of that of the sun from the latter. Her apparent dimensions naturally vary in inverse proportion; and, moreover, she presents the phenomenon of phases. At the epoch of inferior conjunction she turns toward us that one of her two hemispheres which is not illuminared and is consequently invisible to us.

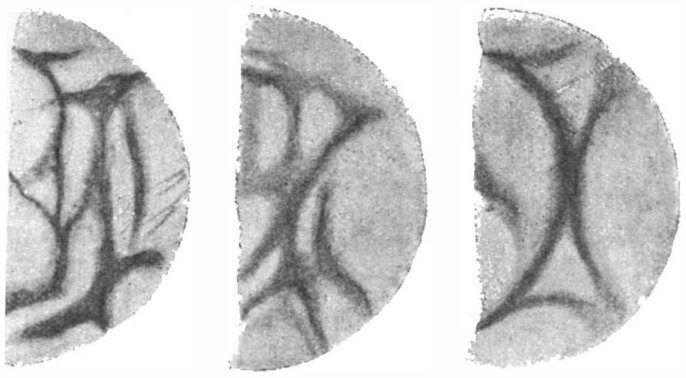


Fig. 2.—VENUS AS OBSERVED BY M. FONTSERE.

Fig. 1.—VENUS AS OBSERVED BY SIR WILLIAM HERSCHEL.

A few days afterward she appears to us in the form of a slender crescent, which continues to widen more and more in measure as she seems to become more distant from the sun on the west side. It is then that we see her shining in the morning before sunrise and that she is called the "Morning Star." She gradually assumes the form of a half moon, and then the visible part further enlarges, and finally comes the superior conjunction, in which she presents to us the whole of her illuminated hemisphere. Unfortunately, she then appears alongside of the sun and is lost in the splendor of his light. Then her apparent figure undergoes the same modifications in an opposite direction, while she appears in the evening to the east of the sun until the epoch of the new inferior conjunction. It must be added that, on account of the variations in the distance of Venus from the earth, the apparent diameter of the planet is so much the greater in proportion as the phase is more pronounced. It is when she appears in the form of a slender crescent that her diameter seems greatest. Fig. 4 shows the different aspects of the planet, with their relative apparent sizes. We shall not dwell upon this farther, but we have thought it well to recall all these circumstances in order to show how unfavorable they are for observations; added to which, among other difficulties, is the fact that we never see the planet's entire disk. So it is not surprising that the knowledge that we possess as to this planet is much less advanced than that which we have been able to acquire concerning the moon or the planet Mars.

There is one thing certain, however, and that is that Venus is surrounded by an atmosphere much denser and much higher than that of the earth. The existence and thickness of this atmosphere reveal themselves to our eyes (1) by the penumbra that accompanies the internal limit of the crescent, and that corresponds to the twilight of the places on Venus for which the sun rises and sets; (2) by the prolongation of the horns of the crescent beyond their geometrical limit; (3) by the fact that the external edge of the planet is always more brilliant than the central region; and (4) by the observations made at the time of the last passage of Venus over the sun's disk, and which showed, at the moment at which Venus' disk had half entered upon that of the sun in the form of a black semicircle, that the part of Venus remaining external to the sun was surrounded by a narrow luminous ring produced by the illumination of the atmosphere (Fig. 5). M. Bouquet de la Grye, who has discussed these observations, estimates that the atmosphere of Venus is five times higher than that of the earth. Finally, spectrum analysis has shown aqueous vapor in this atmosphere, and hence it is allowable to conclude that more or less opaque clouds exist. So this atmospheric stratum, which acts as a veil to conceal the solid part of the planet from us, constitutes still another difficulty.

The first problem to be solved would be that of the determination of the rotation of the planet and of the position of its axis. Now, as regards this, the opinions of astronomers have singularly varied. The reason of this is that, in order to solve the problem, it would be necessary to distinguish persistent spots upon the surface of the planet and follow their apparent motion, as has been done with the moon, the sun, Mars and Jupiter. Unfortunately, we see almost nothing upon the planet Venus. Many astronomers have never seen here anything but a surface of a uniform white. Others have seen, or thought they have seen, dark or white spots. But such spots are scarcely perceptible and without exact contours, and are nothing more than fugacious and ill-determined shadows. Another curious circumstance is that, although the drawings made by the same observer present some resemblances to each other, those obtained by different observers are entirely dissimilar, as one may convince himself by examining the engravings which accompany this article. It has never been possible to identify upon Venus, as it has been upon Mars, two spots seen by different observers. So the maps of Venus that have been published a little too hastily are absolutely illusory.

The first observations date back to Dominique Cassini, who made them at Bologna in 1666 and 1667. We give (Fig. 3, No. 1) one of Cassini's sketches repro-

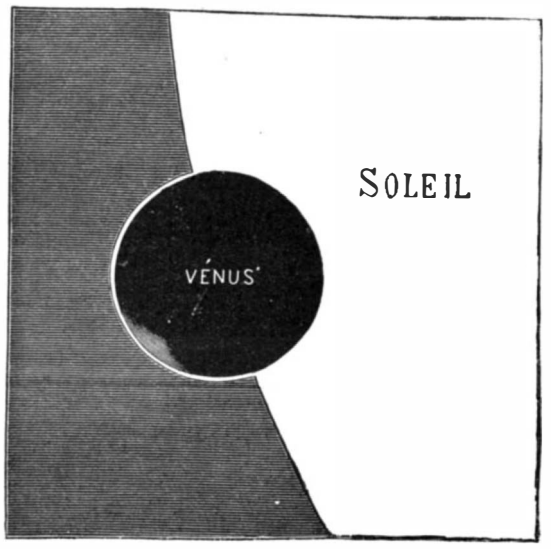


Fig 5.—LUMINOUS RING PRODUCED AROUND VENUS BY THE REFRACTION OF THE SOLAR LIGHT THROUGH ITS ATMOSPHERE AT THE MOMENT OF ITS PASSAGE OVER THE SOLAR DISK.

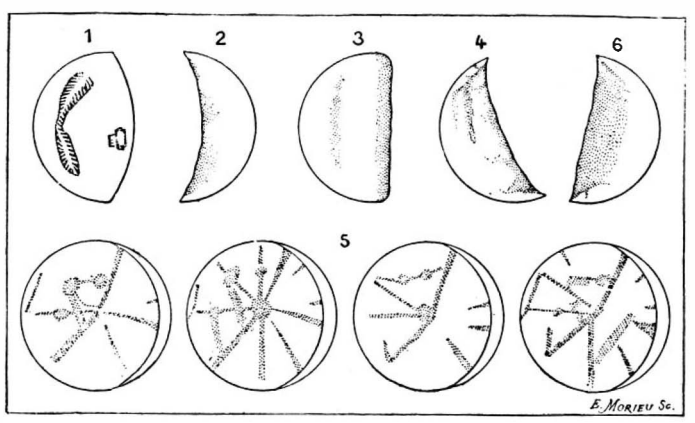


Fig. 3.—OBSERVATIONS OF VENUS.

No. 1, by Cassini; No. 2, by Bianchini; No. 3, by Schroeter; No. 4, by Schiaparelli; No. 5, by Lowell; No. 6, by Flammarion and Antoniadi.

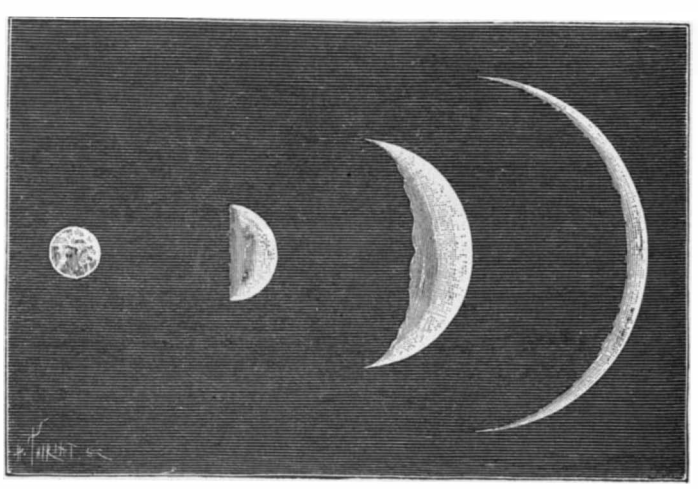


Fig. 4.—PHASES OF THE PLANET VENUS—ASPECTS AND APPARENT DIMENSIONS AT DIFFERENT EPOCHS.

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duced in the Bulletin of the Astronomical Society of France. Upon the right, near the terminator, we observe a white spot which has never been seen since, and from which Jacques Cassini, son of Dominique, concluded that the planet made one rotation in a little less than twenty-four hours around an axis lying nearly in the plane of the orbit.

In 1726, Bianchini, one of whose sketches is reproduced in No. 2 of Fig. 3, concluded on a period of revolution of 24 days and 8 hours. No. 3 of Fig. 3 shows us a drawing by Schroeter made in 1788. This astronomer estimates the duration of the rotation at 23 hours and 21 minutes; but he must have allowed himself to be influenced by Cassini's figures, since a profound discussion of his drawings scarcely permits of deducing anything therefrom. William Herschel, whose ability and patience are well known, gave up the observation of Venus, and judged that the spots often assume the aspect of optical illusions. Fig. 1 reproduces one of his drawings. In 1878, Schiaparelli announced that the very careful observations that he had made at Milan could not be made to agree with the rotation of twenty-four hours nor with that of twenty-three days, nor even with any relatively short period. It must be admitted that the period of rotation of Venus on its axis is just equal to that of its revolution around the sun, so that the planet would always turn the same hemisphere toward the sun in the same manner that the moon always presents the same face to us. In this hypothesis, one of the halves of Venus would have light and heat eternally, while the other would remain eternally in cold and darkness. Schiaparelli's opinion is based especially upon the persistence of a spot or rather of a shadow near the southern horn (Fig. 3, No. 4). As the drawing is reversed, the southern horn is the upper one. This shadow remains visible at the same place for hours, days, months and years.

Finally, in 1896, Mr. Percival Lowell, whose remarkable observations relative to the planet Mars we have recently referred to, obtained at his observatory, under excellent atmospheric conditions, some drawings, a few of which we reproduce herewith (Fig. 3, No. 5). The planet was observed in broad daylight at an epoch near that of the superior conjunction. These singular configurations underwent but little change from one hour to another, and Mr. Lowell saw therein a confirmation of Schiaparelli's ideas and of the duration of axial rotation equal to that of the revolution. If it be added that Mr. Barnard, at the Lick Observatory, declares that he has never been able to distinguish any certain spot upon the planet, save once, and if a few other observations be taken into account, particularly those made at Juvisy by MM. Flammarion and Antoniadi (Fig. 3, No. 6) and in Spain by M. Fontsere (Fig. 2), we shall have all the elements of the question.

It remains to discuss all these observations and to draw a conclusion therefrom. This is what M. Flammarion has recently tried to do. In the first place, the want of resemblance of all the drawings leads to the supposition that many of the configurations sketched are pure illusions. The surprising drawings of Mr. Lowell, notwithstanding the authority of that astronomer, appear to come under this head. If we reflect upon the radiating aspect of the black lines observed and upon the fact that analogous configurations have been observed upon other planetary disks, notably upon the satellites of Jupiter, we shall be led to see therein an effect of optics due to the passage of the light through the glasses of the telescope, diffractions, interferences, etc. If we examine the other drawings, we shall find therein nothing in common except a sort of shadow which starts from each of the horns of the crescent and spreads out over the central part of the disk. According to Schiaparelli, this shadow is larger and more pronounced in the vicinity of the southern horn, and it is the persistence of it that has led to the admission of one revolution in 224 days. Now M. Flammarion remarks that the very form of this shadow leads one to think that it is produced in the atmosphere of Venus and has more relation with the phase and with the solar illumination than with the body itself of the planet. In other words, this shadow is a consequence of the manner in which the planet is illuminated, and that may occur in two ways: it may happen that it is an effect of optics, of which, it is true, it would remain to explain the cause; but it may happen also that it has an objective existence in the atmosphere of the planet. Do we not see upon the earth itself, for several days in succession, the same atmospheric conditions reproduce themselves at the same hours—fog in the morning, clouds in the daytime and clear spots toward the end of the day and at sunset? An observer who should see the earth from afar, under such circumstances, would evidently perceive atmospheric shadows that occupied an invariable place with respect to the line of the points in which the sun sets or rises, that is to say, with respect to the terminator. This is probably what happens upon Venus. The points in which we see Schiaparelli's persistent shadow are always at the same hour, and have, if we may so express ourselves, the same meteorological heavens for a longer or shorter period. So the persistence of this shadow no longer implies the absence of relative rotation of the planet. The latter really revolves, but the atmospheric shadows follow the illumination, and we see them always at the same place, although in reality they shift about with respect to the regions of Venus.

This theory evidently supposes that we never see the solid surface of the planet and that we observe the atmosphere only. Now, there are strong reasons for thinking that this is the case. In the first place, among these is the undecided character of the spots observed, and especially the thickness of the atmosphere of Venus. Being given the relative proximity of the sun, the heat that results therefrom and the activity of the evaporation that is the consequence of it, it would not be surprising if the atmosphere of Venus were constantly filled with clouds, as so often happens with that of the earth.

In this case it is evident that we should see only such uniform stratum of clouds. But this hypothesis is not necessary.

Even though the atmosphere of Venus were as pure as our serenest sky, it is almost certain that it would again prevent us from seeing the solid surface. In order to convince ourselves of this, it suffices to observe that the terrestrial atmosphere absorbs more than a third of the solar light. This absorbed light is not destroyed, but is diffused in all directions, and is what produces the blue brilliancy of the sky. Seen from the exterior, the atmosphere would be as luminous as is the serene sky, and this continuous brilliancy would certainly much interfere with, if not entirely prevent, a view of the details of the surface. Let us add the light reflected by the sun would also lose another third of its intensity in traversing the atmosphere anew; whence it follows that, to an external observer, the presence of the atmosphere would diminish the brilliancy of the terrestrial surface by two-thirds and produce, besides, a luminous field upon which the details of the surface would be lost. Under such conditions, it is very likely that the observer would be able to distinguish our seas and our continents only with the greatest difficulty. As regards Venus, the atmosphere of which is much denser, this effect is assuredly more marked. Upon Mars, the atmosphere, although relatively rare, effaces the configurations in the vicinity of the edge, where the luminous rays traverse it obliquely upon a greater thickness. Upon Venus such effect of effacement is likely produced as far as to the center.

Such are the new ideas which M. Flammarion has just submitted to astronomers in the October number of the Bulletin of the Astronomical Society, and which by word of mouth he laid before the members at the session of November 3. It is impossible not to recognize with what likelihood they present themselves. One may regret that they end in the impossibility of determining the rotation of the planet by an observation of the disk, but the fact that a theory leads to disagreeable conclusions does not diminish its degree of probability. Fortunately, there is another manner of attacking the problem, and that is by spectrum analysis and the application of the Fizeau-Doppler method. But the latter method, as concerns the planets, presents special difficulties, and it will perhaps be necessary to wait a long time before it is possible to obtain any serious results by this means. The above article was contributed to La Nature by M. Fouché.

The Current Supplement.

The current number of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1153, contains a number of articles which are specially interesting to the general reader. These articles take up the topics of the day, such as "Prince Henry and His Fleet," "The Dreyfus Trouble in Paris," "China of To-Day," "Opening of the Sarcophagi of Voltaire and Rousseau." All of these articles, except the one on China, are well illustrated. Technology is represented by an important paper by J. A. Brashear on "Optical Glass." In the electrical field will be found articles on "Electricity in Cotton Mills" and "Effect of Electric Currents on Adjacent and Surrounding Buildings." The usual notes present the shorter matter gathered from the press of the world. "A Drowned Continent" and "Raindrops: Their Size and Rate of Fall" are interesting scientific articles.

Exhibition at Dijon, France, This Year.

Information has been received from the Foreign Office, through the Science and Art Department, that a universal and international exhibition will be opened at Dijon on June 1, 1898. The exhibition will remain open until October 31. There will be 14 sections —(1) Fine Arts, (2) Social Economy, (3) Hygiene, (4) Salvage, (5) Industrial and Decorative Arts, Liberal Arts, Science, (6) Heating and Ventilation, (7) Electricity, Traction, (8) Military Art, (9) Manufactures, (10) Sport, (11) Exercises, Popular Games, (12) Conferences on Agriculture and Horticulture, (13) Education and Work of Women, (14) Commerce, Colonies. All communications should be addressed to the General Manager or Organizing Committee, Rue Monge 38, Dijon.

Science Notes.

Mr. Thomas Fletcher has recently published an estimate of the amount of coal gas needed to maintain an ordinary small fire clay muffle at the proper temperature for various purposes, and using the gas in atmospheric burners. For hardening steel cutters, etc., which requires clear red heat, about 8 cubic feet of gas per hour are needed for every 10 square inches of floor area of the muffle. A yellow such as needed in silver assay work requires a consumption of 10 cubic feet of gas per hour, while the bright yellow used in gold assays requires about 11 cubic feet per hour. For still higher temperatures, such as needed in china enamels, etc., the consumption may go up to 14 cubic feet of gas per hour for every 10 square inches of the floor area of the muffle. Where metal muffles can be used, or the gas can be burned under pressure, a smaller consumption is needed.

It will be remembered that in 1895 the original MS. of Gilbert White's "Natural History of Selborne" was sold by Messrs. Sotheby for $1,470, says Nature. It is now announced that the same firm will offer for sale an even more interesting batch of writings by the same author. These MSS. are the original letters which were sent by post by Gilbert White to Thomas Pennant between August 10, 1767, and July 8, 1773. These letters were returned to Gilbert White when he first conceived the idea of writing his famous natural history and from them was drawn up the autograph MS. sold in 1895. The letters are all holograph but four, which are in the handwriting of an amanuensis, signed by Gilbert White, and all but three occupy four pages folio. They are additionally interesting and valuable from the fact that many of the details recorded in them were altered, omitted or augmented in the published work. The second lot of Gilbert White MSS. is "A Garden Kalendar," dating from 1751 to 1767. It is the author's holograph manuscript, and occupies 424 pages. This has never been published, excepting the portion May 1 to November 16, 1759; it is in the form of a consecutive diary, recording the writer's almost daily operations on his own land, and notes of the results of experiments tried by him in forcing and hothouse work. All the MSS. have been continuously in the possession of the White family.

Sun's Eclipse in India.

Press reports from India state that the weather was perfect and that favorable results were secured during the eclipse of January 22. The totality at Buxar lasted one and one-half minutes. Five special trains went to this place filled with Europeans. Immense crowds of natives bathed at Calcutta, Benares and at other centers during the eclipse. At Dumoraon seven good pictures of the corona were obtained. The spectacle was magnificent and excited awe and astonishment among all the beholders. It is a curious fact that the natives in many places regard the event as presaging the downfall of their British rulers. All the observations of the eclipse by E. W. Maunder and C. H. T. Waites at Talni, British India, were most successful. The sky was perfectly clear and light. During the middle of the totality it equaled a full moon. The general shape of the sun's corona was the same as in the eclipse of 1886 and 1896. The corona extended over two diameters from the sun and its greatest extent was along the sun's equator. Photographs were obtained on a scale of four-fifths of an inch to the sun's diameter and also on the scale of one-tenth of an inch to get the coronal extensions. Good spectrum photographs were also obtained. A cablegram received at Mt. Hamilton, California, from Prof. Campbell, who is in charge of the Lick Observatory expedition in India, states that most satisfying photographs of the corona were obtained by the expedition with three different telescopes. Prof. Campbell photographed the changes in the solar spectrum at the sun's edge with the aid of one of the spectroscopes.

The total solar eclipse was visible in Asia, Eastern and Central Europe and in northeast Central Africa. The belt of the shadow extended from the Pacific Ocean southwesterly through Korea, through the easterly and central provinces of China, India, the Arabian Sea and Indian Ocean to a point in Central Africa about half way between the source of the Niger and Nile Valley. Besides the official observations that were made at the native stations in China and India, the total eclipse was viewed in the Orient by astronomical expeditions from England, France, Germany and from the Lick Observatory. The last-named expedition has its quarters at Rutnagari, India. England sent three official expeditions to India. One was under the control of Sir Norman Lockyer and A. Fowler. The second comprised the Astronomer Royal, W. H. N. Christie, Prof. H. H. Turner, of Oxford, and Dr. A. A. Common. The third party consisted of E. H. Newall, of Cambridge, Capt. Hills and the Astronomer Royal of Scotland. Dr. Copeland. There were also various minor expeditions. Attached to one of the telescopes in Sir Norman's equipment was a cinemetograph which took pictures at the rate of six per second of the changes in the sola corona.

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Correspondence.

The Pole and Chimney Problem.

To the Editor of the SCIENTIFIC AMERICAN:

In the answer to query No. 7293, January 8, is not the length of pole there given the shortest that will touch the hearth and both front and back of the chimney? As the question is printed, the answer would be dependent on the size of the house, as a pole in a position nearly horizontal would be indefinitely long. No mention is made of any particular height up the chimney as being required. It is stated — for maximum l $\frac{dl}{d\alpha} = 0$; but it has not been shown whether this is a maximum or a minimum, as the value of $\frac{d^2l}{d\alpha^2}$ has not been determined. If my calculation is correct, it works out a minimum, the result being $\frac{d^2l}{d\alpha^2} > 0$.

H. S. BURROUGHS.

[Certainly; and it is also true that the shortest straight piece which will touch these three points is the length of the longest pole which will pass these points and go up the chimney.

We fail to understand the question as our correspondent does. By the longest pole, etc., we understand that the pole is to be put into the chimney vertically. When it has entered the chimney it can then be raised to any height desired. The size of the house and the distance it shall go up the chimney after it is in the chimney are not in the question in any way so far as we can see.

The length of pole given is correct for the diagram at the head of the demonstration.

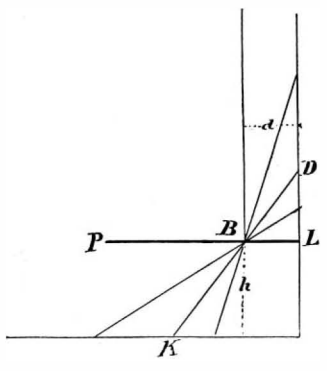
In justice to Prof. Filkins, it should be stated that he showed in his solution that the line A C was a minimum line, as well as the maximum length of pole for the purposes; but as the question only asked for maximum pole, that point was omitted from the answer. Anyone interested can prove this by trigonometry by solving the right triangle with an angle at the base 15° 15′ and 15° 17′. The length A C will be found to be greater in both cases.

The question has no practical value, since anyone who wanted such a pole could soon find with two sticks how long to cut the pole. The practical solution is, to the practical man, just as satisfactory as the mathematical solution is to the mathematician.—ED.]

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 8, page 29, one of your readers asks: What is the longest pole that can be run up a chimney, the height of the mantel being 48 inches and the depth, from front to back, 16 inches?

The solution given leads to a correct answer, but in a roundabout way, and further is misleading as pretending to find a maximum. It really finds a minimum, and this is the reason why: The formula that is differentiated expresses the length of a straight line passing through B (see adjoining figure) and limited by



the floor and by the wall. Such a line, if horizontal or if vertical, is infinitely long, and if neither horizontal nor vertical it is finite, and, in a certain one of its intermediate positions, as DK, it is a minimum; that is, it is shorter than in any other position. Now, supposing the pole PL started in the horizontal position and turned upward into the chimney by keeping it in contact with B and its end L against the wall. It is clear that it will never be able to pass through the intermediate position DK unless it be at least as short as DK.

This minimum value l is given by the rather elegant formula

$$l^{\frac{2}{3}} = h^{\frac{2}{3}} + d^{\frac{2}{3}}$$

whence $l = (h^{\frac{2}{3}} + d^{\frac{2}{3}})^{\frac{3}{2}}$. In the problem as given, h = 48, d = 16.

The cube root of h squared is $\sqrt[3]{48 \times 48} = 13{\cdot}2$

The cube root of d squared is $\sqrt[3]{16 \times 16} = 6{\cdot}3$

The sum is 19·5

and the square root of the cube of the sum 19·5 is 86·5 the length required.

JOSEPH BECKER,
Assistant Examiner Patent Office.

Washington, D. C., January 12, 1898.

[This note does not add anything to our knowledge of the problem for putting a pole up the chimney. It is not clear to a lay mind why the writer should say such a horizontal line is infinitely long. We should suppose the longest horizontal pole which would enter the chimney would be 18 inches long. The chimney is not infinitely deep. Similarly the longest pole to enter vertically is 48 inches long, since the mantel is not an infinite distance above the floor. It is quite necessary to observe the usual arrangement of a chimney and fireplace in discussing this problem, else one is liable to wander from the question. We close this discussion with a note from Prof. Filkins, who prepared the original solution of the problem.—ED.]

To the Editor of the SCIENTIFIC AMERICAN:

The solution of the "chimney problem" given in your issue of January 8, p. 29, by the writer has been extensively criticised, owing to the omission of certain lengthy and unnecessary mathematical amplifications.

The question as asked was, "What is the longest pole that can be run up the chimney" under certain conditions? In choosing notation, the writer preferred that which would simplify the result and shorten the solution, provided persons unversed in the higher mathematics wished to use it.

One communication on the solution makes a criticism covering that part which the writer performed, but did not think necessary to send you. The same communication contains a result, $l^{\frac{2}{3}} = h^{\frac{2}{3}} + d^{\frac{2}{3}}$, which has been styled a "rather elegant formula" and which is evidently considered superior to the other. In reality it is based on the writer's result and may be obtained from it by an extended algebraic and trigonometric process, which the communication fails to give.

CLAUDE W. LE. FILKINS.

Adelphi College, Brooklyn, N. Y., January 19, 1898.

The Temperature of Arid Regions.

Mr. Willis L. Moore, Chief of the United States Weather Bureau, and therefore an accepted authority on matters pertaining to climate, expressed the opinion, in a recent paper on "Some Climatic Features of the Arid Region," that the ideal climate as regards equality of temperature and absence of moisture does not exist in the United States. Such a climate, he says, is found only on the plateaus of the tropics, as, for example, at Santa Fe de Bogota, in Colombia, where the average annual temperature is about 59 degrees. The southeastern part of the United States has the nearest approach to this ideal temperature. Even in the southwest the range of variation is too great, and the rainfall reaches from nothing to a point greater than is to be found in the Eastern or Middle States. The study of meteorological conditions is most interesting, the flavor of speculation that is about it rendering it charmingly attractive. Experts tell us that ranges of temperature depend upon the dryness of the air and the clearness of the sky. Thus, while the summer temperature of the Southwest is high, the real degree of heat as felt by animal life is not indicated by the common thermometer, but by a mercurial thermometer, the bulb of which is wet at the time of the observation. In this manner is shown the temperature of evaporation, the sensible temperature, and, more nearly than can otherwise be indicated, the actual heat of the body.

The inland valleys and plains east of the Rocky Mountain foothills have an average summer temperature of from 65 degrees on the north to 80 degrees on the Gulf coast. While the daytime heat in the arid regions seems excessive, it is not really so, owing to the extreme dryness of the atmosphere. It is, as is well known, the moist, "sticky" heat that is prostrating. Again, in these regions the radiation at night is so great that the temperature is made tolerable, and, indeed, comfortable. Estimated by the temperature of evaporation, the arid region is the coolest part of the country. The falling of temperature from the time of the greatest heat is irregular and not at all dependent upon longitude reckoned west from Greenwich. Mr. Moore cites as an example of this the fact that the temperature falls as much by 6 P. M. in Denver as it does by 8 P. M. in New York and Philadelphia. This is accounted for in the greater daily range and more rapid rate of cooling at elevated stations.

Soap Applied to the Ocean.

The North German Lloyd steamship "Gera," which recently arrived in New York from Bremen, ran into a tempest in midocean on January 7, and shipped the crests of many combers. Her commander decided to try the efficiency of soft soap and oil on the waters. It is, of course, usual for storm-tossed vessels to use oil in the quieting of troubled waters, but the combination of soft soap and oil is rare. It was run from the closet pipes on the weather side, about sixty feet abaft of the beam. About eight gallons of soft soap and four gallons of thick lubricating oil were used. The soft soap was dropped through one pipe and the oil through another nearby. A heavy lather appeared on the sea and the crests ceased breaking aboard. The storm moderated next day and the "Gera" was able to make her usual winter weather speed the rest of the trip.

Recent Archæological News.

At Palestrina, two more fragments of the Prænestine stone calendar of M. Verrius Flaccus have been discovered. They give the observances for August 1, and mention a previously unknown sacrifice to Victoria Virgo on the Palatine Hill.

Michelangelo's poems have just been published by Prof. Frey, of Berlin, the first complete and authentic edition ever issued. He had access to the family archives, which had been almost entirely closed to scholars.

The Italian government has resolved to found at Florence at public expense a library of all the books which have incurred the censure of the Sacred Congregation of the Index. The Vatican has protested against the measure, on the ground that the majority of the books in question are improper to the last degree, and that the establishment of a collection of such a nature is an affront rather against public morality than against the discipline of the church.

William Tell has dwindled into a myth. Rousseau's tomb, which has been the bourne of so many pilgrimages during the last hundred years, has now been discovered to be untenanted, and now Bonivard, the "Prisoner of Chillon," so beautifully sung of by Lord Byron, is shown to be something very much akin to a fraud. Visitors to the old Castle of Chillon, on the Lake of Geneva, have long gazed with reverent eyes on the track worn in the stone pavement around the pillar to which the captive was chained during his long incarceration. This year the famous footprints mysteriously disappeared. An inquiry was made in the Cantonal Legislature as to what had become of them. Thereupon M. Vecqurat, Councilor of State, rose and unblushingly explained that they had never existed at all, but were artificially manufactured to satisfy the demands of a sentimental public. This year the usual repairs were done so late that there was no time to renew this venerable sham.

For more than 1,800 years, says The New York Times, the city of Mainz, or Mayence, as most people who do not live there call it, has been a walled and fortified place, with most considerations of convenience and commerce subordinated to those of war. At last, however, it has been decided that perhaps the residents of the town will be in no great danger if the ancient bulwarks are taken down. Anyhow, the experiment is to be tried, and as soon as the value of the land on which the walls stand can be settled the work of demolition is to begin. This land, of course, is government property, and the official assessors think that it is worth $1,000,000. The citizens regard the price as high, but they will doubtless pay the sum demanded, since the rigid cordon is a terrible nuisance to them and a constant obstacle to the expansion of the city. The military authorities of Germany are said to view the matter with indifference, as opinions respecting the strategical value of fortified towns has changed much since the siege of Paris. The present tendency is to attach no importance to fortresses not directly on a frontier, and not even Emperor William thinks of building stone fences around his capital.

The Rome correspondent of The Times writes: An important decision regarding the export duties laid on such articles of commerce as fall under the very vague and elastic heading of "antiquities" has just been rendered by the Court of Appeals in Rome. As is known to all who have attempted to purchase such articles there, the export duty of 20 per cent levied on them by a law which is an inheritance from the Papal government is not only a grave charge, but one which it is sometimes embarrassing to determine, the value of such things being purely fantastic. The law, known as the Pacca edict, applies only to the late Papal territory, each one of the ancient realms of Italy having still its ancient regulation, the duty from Tuscany being one per cent and that from the former Austrian possessions nil. The Roman court has decided that it only applies to such objects as are recognized as "precious," i. e., as of exceptional artistic or historical value. The limitation is as vague as the old definition, and perhaps the best results of the decision will be to compel the government to pass a general and rational law, under which the possessor of an object having value from its antiquity shall be free to carry it out of Italy. Prof. Villari, when Minister of Public Instruction, proposed a sensible and comprehensive law, which, while imposing a small duty and the necessity of a permission to export, for the purpose of controlling the exportation of the heirlooms of the nation, made it indispensable for the government either to purchase or permit the exportation. This law, like most of those which the public good has called for, has ever since lain covered by the petty legislation for electoral purposes, which impedes all useful reforms other than those demanded by the constituents of the ministerial deputies. If an object is precious and indispensable to the honor or history of Italy, it is reasonable that its exportation should be prevented, but only by purchase, for it is an outrage that a man may not dispose according to his interest or necessities of articles which are his unquestionable property.

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THE CROTON RIVER DAM, NEW YORK WATER SUPPLY.

The Croton watershed, the source of the water supply of New York, is located from thirty to forty miles north of the city. It has a catchment area of 361·8 square miles, with an average yearly rainfall of 45·97 inches and an average yearly flow of 135,400,000,000 gallons.

The Croton reservoir, which forms the present water supply of the city, is located about six miles from Croton Landing, where the river of that name empties into the Hudson. It was constructed some fifty years ago and has a capacity of about 1,000,000,000 gallons. While this storage was ample for the population of 350,000 which New York contained at the time the dam was built, it is inadequate to the needs of the present population of 2,000,000. The new Croton dam, which is being built across the valley at a point 3¼ miles below the present dam, is part of a great scheme for improving the water supply by increasing the storage capacity to 30,000,000,000 gallons.

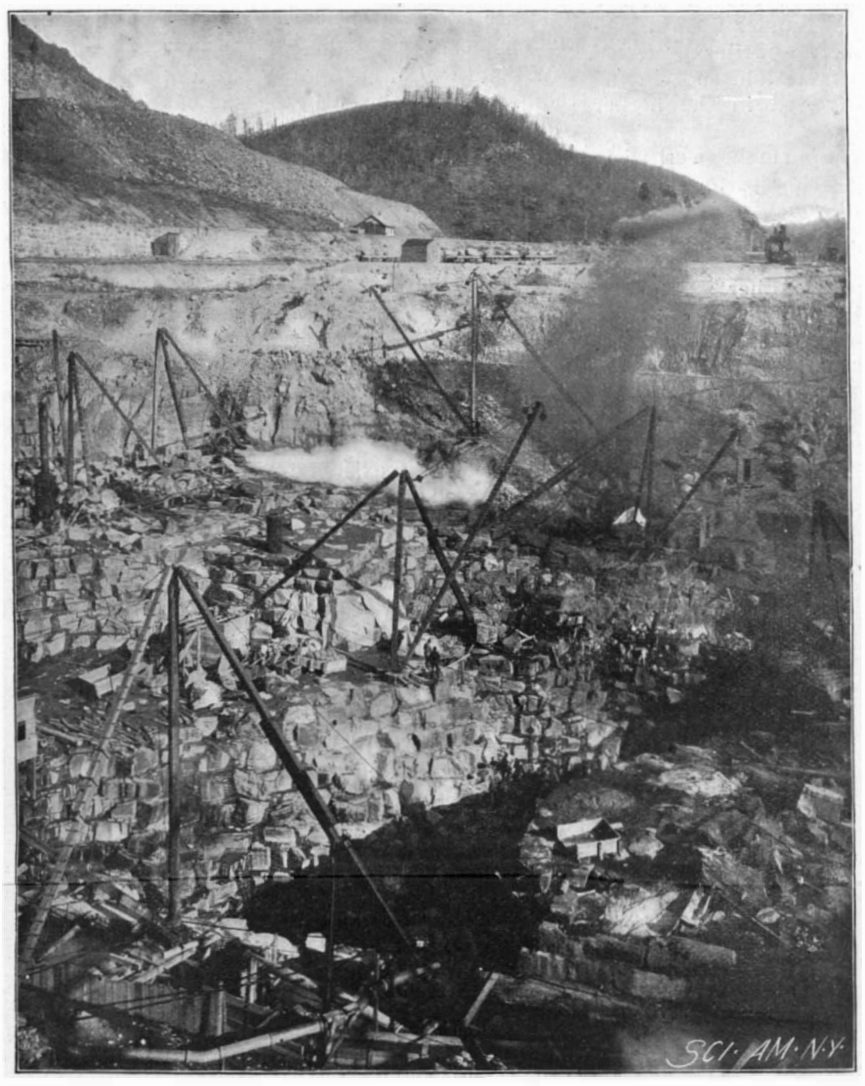
In many respects this is the most monumental work of its kind in existence. The total length of the dam will be over 1,000 feet and the spillway will extend another 1,000 feet upstream, parallel with the side of the hill. The total height of the masonry dam from foundation to crest varies, but where the foundations are deepest it will be approximately 300 feet. In excavating the vast trench for the foundations it was necessary to remove 880,000 cubic yards of earth, sand and gravel and 89,000 cubic yards of rock. When the great dam has been raised to its full height it will contain 640,000 yards of rubble masonry laid in cement, the whole work will have occupied thirteen years in construction and the cost will have reached some $4,500,000.

In the whole range of engineering works there is nothing that requires greater patience, care and skill than the erection of a colossal dam like this. It is no child's play to raise across the valley a giant wall that shall hold back the waters of a great lake, whose aggregate pressure tending to overturn the structure is 340,000 tons. Not only must the wall be given sufficient weight and sufficient breadth of base to resist the tendency of the water pressure to turn it bodily over and hurl it down the valley, but it must be rooted to the native rock of the hillside and valley bottom with such an intimate contact that not the most infinitesimal stream of water can percolate through. This would be a matter requiring care, if the water were but 10 or 20 feet deep; but at depths of 160 feet (the depth of the reservoir at the dam), where the hydraulic pressure is 5 tons on every square foot of the wall, the engineers must exercise the closest vigilance to see that the masonry is securely laid. Indeed, at the bottom of the foundations the hydraulic pressure would be about 9 tons per square foot or 125 pounds per square inch.

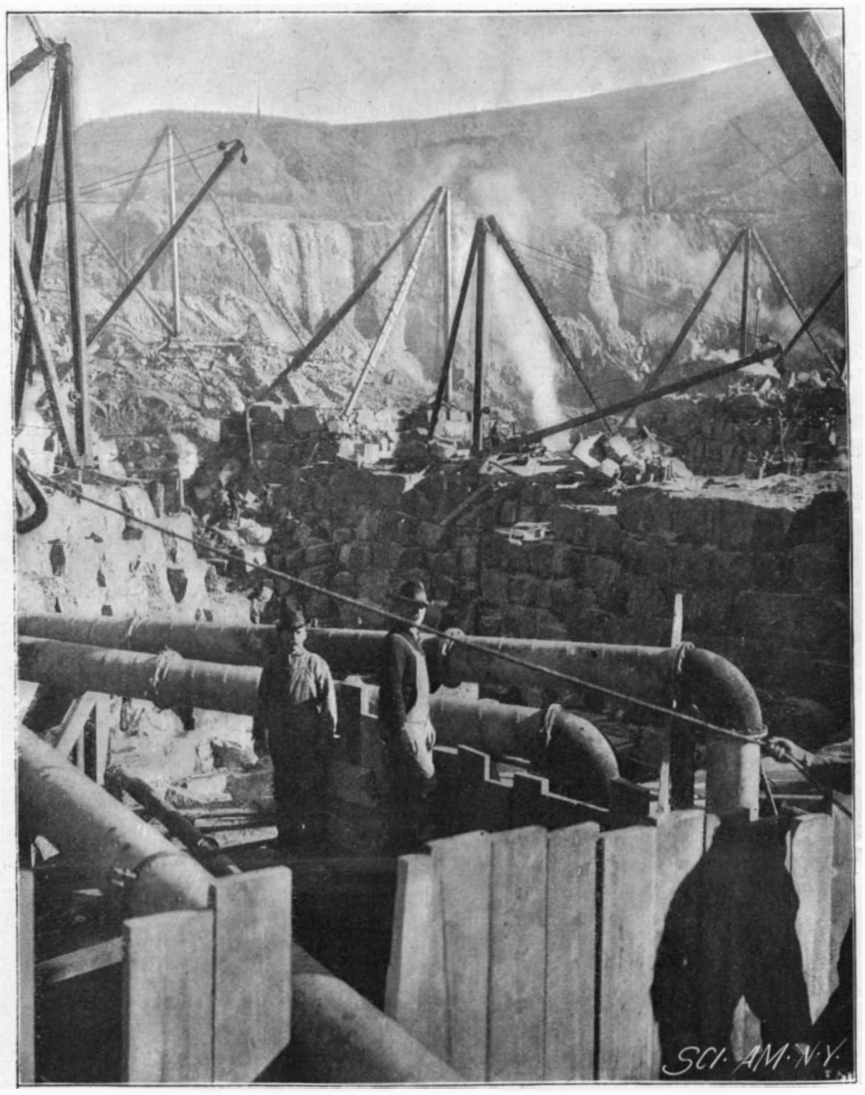
Under this head water would soon cut a large channel for itself through soft rock or any loose material. Hence it is necessary in building a dam like this to carry the foundations down to solid rock at every point. All the alluvial sand, gravel, etc., which has been deposited by the river in the course of ages has to be excavated until a firm, impervious quality of rock is laid bare. In the case of the Croton dam it was necessary to go down in some places 130 feet below the original river bed, and as the dam foundation is over 200 feet in width, the reader can form some idea of the vast chasm which has been dug out across the valley at this point.

Before the excavation was commenced, however, it was necessary to provide a temporary channel to convey the Croton River past the work (Fig. 3). To this end the toe of the hill on the north side of the valley was blasted away, and a channel was formed by constructing 600 feet of wall, 20 feet high, across the line of the dam, with two wing dams at each end of the wall—the wall and wing dams being built at a distance of 125 feet from the toe of the hill. A distant view of this temporary channel is shown in Figs. 2 and 7 and a view looking up the channel in Fig. 3. When the channel was complete, the north bank of the river was cut, diverting the waters into it and leaving the site of the dam dry.

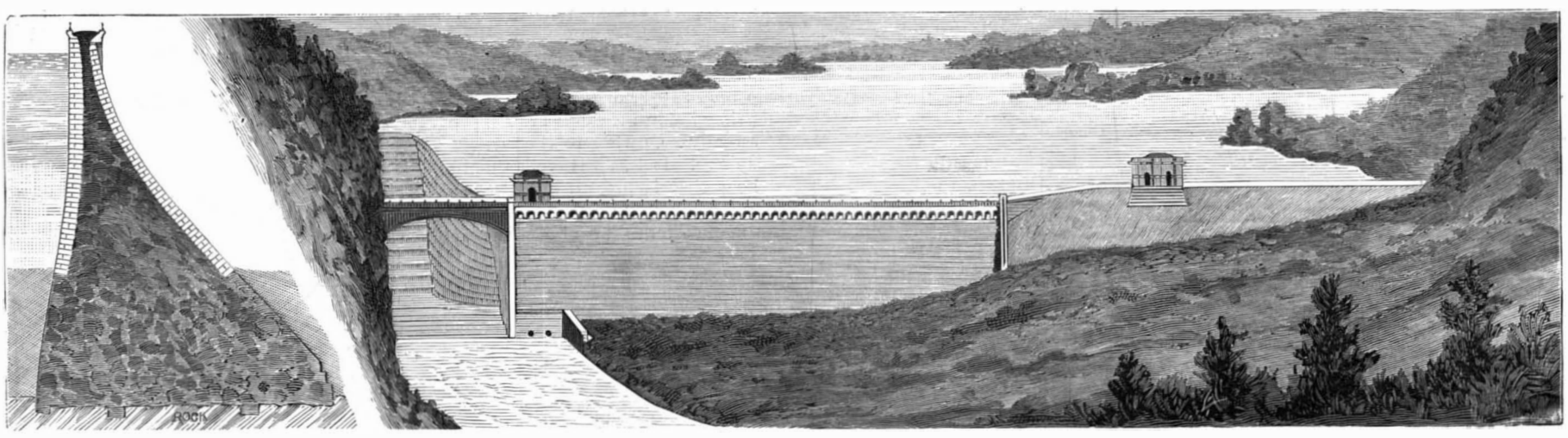
The excavation was carried on by the various well-known mechanical systems, such as suspended cableways, steam shovels and dredges. Tracks were run into the excavation and material was brought out and carried to the dumps above and below the dam by the train load. All loose material was carefully cleared away and in every case excavation was carried down to solid rock. Owing to the irregular lay of the rock, the depth of the foundation varies greatly, the lowest courses being as stated 130 feet below the bed of the river. After the surface of the rock had been cleaned, the work of building the rubble masonry commenced. The first four courses, as a rule, were laid in cement, the proportion of which was one part of Portland cement to two of sand. In the upper courses of masonry the proportions are one of American cement to two of sand. The rock is laid in large blocks about three feet in height,



4.—GROUP OF DERRICKS AT WORK IN THE GREAT EXCAVATION. THE TRAIN OF CARS IS AT LEVEL OF RIVER BED.



5.—DRAINAGE PIPES AND MASONRY ONE HUNDRED FEET BELOW ORIGINAL BED OF RIVER.



6.—THE COMPLETED DAM.

NEW YORK CITY WATER SUPPLY—NEW CROTON DAM.

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the joints being filled in carefully with smaller rock and cement. The rock is blasted from a neighboring quarry and brought to the dam by a railroad which runs across the north end of the dam below the wall of the temporary channel (see Fig. 2). Here the skips are picked up by a cableway, which stretches across the valley, carried over to the desired spot and lowered. The rock is then picked up and placed in position by derricks, of which a great number are scattered over the work. Some idea of the magnitude of the work may be gained when it is stated that the booms of the derricks, shown on the foundations in Fig. 7, are 50 feet long. In this general view of the foundations the level of the crest of the finished dam is indicated by a cross on the side of the hill.

The general appearance and cross section of the finished dam is shown in Fig. 6. It consists of three distinct portions. The first 400 feet on the south side of the valley is an earth dam, with an interior masonry core wall. Next to this is the masonry dam, 650 feet in length, which extends to within 200 feet of the north side of the valley. Here it bends sharply to the right and runs back up the valley parallel to the contours of the hillside for about 1,000 feet, finally turning into a junction with the hill. This last portion is the spillway or overflow. At the upper end the latter is comparatively narrow and shallow, but it widens and grows deeper toward the dam proper, of which it is really a prolongation. Its downstream face is formed in a series of large steps as shown in Fig. 6. The spillway is given these generous proportions with a view to accommodate any possible flood that might descend upon the lake. The Croton Lake will be only one of a series of smaller reservoirs scattered higher up in the hills. If any one of these should break, the Croton spillway could safely accommodate the sudden rush of water.

The upstream face of the masonry dam will be approximately vertical, but the other face will run back with a sharp inclination, rounding up to the perpendicular at the coping. The excavated material on the up and down stream sides will be filled in against the dam up to the original level of the river bed, and the two faces of the dam above this level will be finished in facing stone masonry in horizontal courses, laid everywhere at right angles to the face of the dam. It is interesting to note that the pressure of this great wall of masonry on the foundations is 18 tons per square foot.

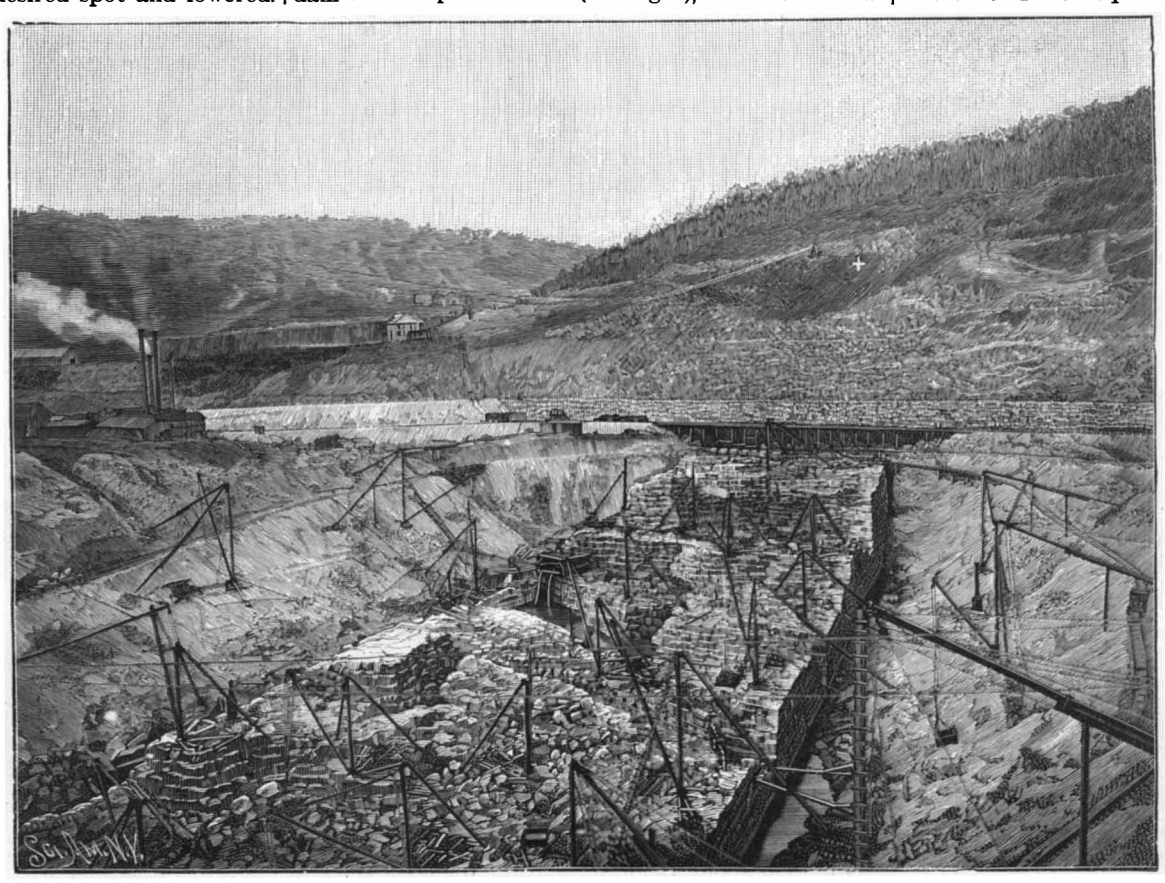
The earth dam is laid in 6 inch layers, from which all large stores are removed. Each layer is rolled with a grooved roller and watered. The water forms a bond and the roller packs the whole mass firmly together. The dead weight of the earth backing affords the necessary stability to resist the thrust of the water, the center core of masonry serving merely to render the dam watertight. This masonry core extends from the great masonry dam to the south side of the valley, and like it extends to solid rock both below the bed of the river and at the side of the hill. It is 18 feet thick at the bottom, 6 feet thick at the top, and its greatest height is about 230 feet. The downstream slope of the earth dam is sodded and the upstream slope is paved.

Along the crest of the dam extends an ornamental driveway which is carried across the spillway by a handsome steel bridge. The driveway is 18 feet wide, with a margin on each side for the necessary railing and coping, and the architectural appearance of the masonry dam is improved by an ornamental line of arches at the coping.

At the extreme north end of the dam will be built a blow-off gate house, for emptying the reservoir, should occasion necessitate it. It will be built out from the dam on the upstream side (see Fig. 6), its dimensions at the top being 35½ by 37 feet. The water will be blown off through three 48-inch pipes, which will lead through the masonry of the dam and discharge into the bed of the river. When the new aqueduct, which runs in a direct line and chiefly in tunnel from the old reservoir to New York, was built, it was provided with a gate house which is arranged so that it can take water from the new reservoir and lead it direct to New York by the new aqueduct. The old aqueduct runs down the south side of the valley from the old Croton dam and intersects the earth dam. At the point of intersection a gate house will be built whose intake will lead water from the lake at various elevations.

The crest of the Croton dam, 3¼ miles upstream, is 30 feet lower than the crest of the new dam. Hence, when the new reservoir is filled, the level of the lake will be 30 feet above the crest of the old structure The total water area will be about 8 square miles and the lake will extend as far as Croton Falls, fifteen miles up the valley.

The plans of this great work were drawn up by Chief Engineer Fteley, the recently elected President of the American Society of Civil Engineers, and the construction is being carried out under the immediate supervision of Divisional Engineer C. S. Gowan.



7.—GENERAL VIEW OF DAM FOUNDATIONS, SHOWING TEMPORARY CHANNEL AROUND NORTH END OF DAM.

Cross on hillside marks level of crest of dam.

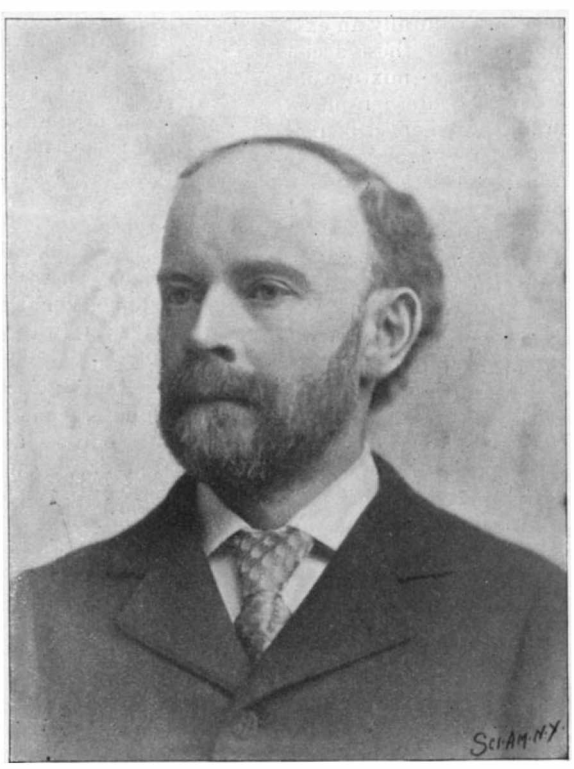
HON. CHARLES H. DUELL, COMMISSIONER OF PATENTS.

The United States Patent Office has been again favored with a Commissioner of known ability and probity. There is hardly a public man in the official life of Washington who is charged with more responsibility than the Commissioner, on whom rests the conservation of great interests. It is requisite that the incumbent of this office shall have a competent knowledge of practice before the Patent Office and be a lawyer as well. Mr. Charles H. Duell, of Syracuse, New York, who has been appointed by the President, admirably fulfills both of these qualifications. He has long ranked high as a practitioner in patent cases before the courts and he probably has few equals in this specialty. His practice has been extensive and has covered a great number of cases. He has attained a large degree of success, having had many cases where the interests involved were of large import. These he has handled with skill and prudence.

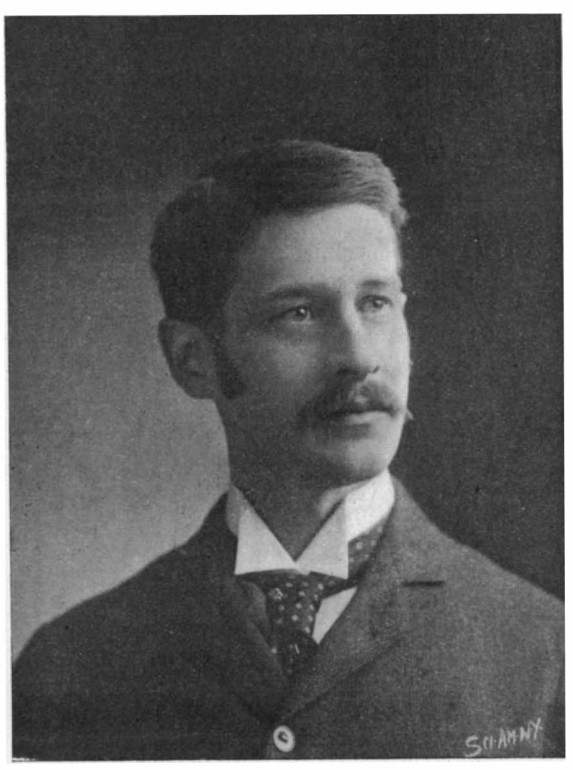
The appointment will probably mean a considerable financial sacrifice, as it will interrupt a lucrative practice and the position of honor to which he has been appointed is inadequately paid. Mr. Duell's appointment will be received with general public favor and it is considered one of the most fortunate of President McKinley's nominations. The new Commissioner was a candidate at the beginning of President McKinley's administration, but the latter wished to appoint his old personal friend, Congressman Butterworth. The death of Mr. Butterworth gave the President the opportunity of recognizing Mr. Duell's candidacy by nominating him.

Mr. Duell was born at Cortland, N. Y., in 1850; his father, R. Holland Duell, was four times sent to Congress, and in 1875 he was appointed Commissioner of Patents, which office he held for two years. Mr. C. H. Duell received a preliminary education in the Cortland Normal School; he then entered Hamilton College, from which he graduated in 1871. He was an honor man in his class and took several prizes. He has held some political offices honorably and acceptably to his constituents.

The inventors of the United States may feel sure that their interests will be looked after in a conscientious manner both in Congress and in the administration of the Patent Office.



HON. CHARLES H. DUELL, COMMISSIONER OF PATENTS.



JUDGE A. P. GREELEY, ASSISTANT COMMISSIONER OF PATENTS.

JUDGE ARTHUR P. GREELEY.

The duties of the Commissioner of Patents are severe, and each new incumbent of the office must spend a considerable length of time in mastering the detail of the office. The manifold duties of the position render it essential that the Assistant Commissioner shall be thoroughly conversant with the administrative and judicial features of so great an establishment, so that he will be properly equipped to assist the Commissioner and take his place in the absence of his chief. In these respects the present incumbent, Judge Arthur P. Greeley, is well equipped for the responsible position of Assistant Commissioner of Patents.

Mr. Greeley is a graduate of Dartmouth College, in the class of 1883. He is a lawyer by profession, having been graduated from the law school of the Columbian University of Washington in the class of 1887, taking the post-graduate course at the same school the following year. The next year, 1888, he was admitted to practice in the District of Columbia.

In July, 1884, he entered the Patent Office as a fourth assistant examiner, as a result of his standing in the

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first examination for appointment to the Patent Office held under the present civil service law. Was promoted through the successive grades of third, second and first assistant and principal examiner solely on merit as the result of standing in competitive examinations held in the office.

As an assistant examiner he served in the division of metal working B and electricity B, in the latter division having charge of the class of electric railways.

On appointment as principal examiner in July, 1891, he was assigned to a newly formed division comprising packing and storing vessels, advertising, etc. He was transferred in 1894 to the division of instruments of precision, and while in charge of this division for a number of months, acted also as examiner of trade marks.

From 1891 to 1893 he was a member of the committee having in charge the preparation, arrangement and installation of the exhibit of the Patent Office at the Chicago World's Fair, which involved an extended consideration of the development of nearly every important art represented in the Patent Office. He was also a member of the committee having charge of the preparation and installation of the Patent Office exhibit at Atlanta.

He is one of the first under the present civil service law to be appointed and advanced through the successive grades and to receive a presidential appointment on merit solely.

The value of the civil service requirements as applied to the United States Patent Office is illustrated by the appointment on April 1, 1895, of Mr. Greeley, of Concord, New Hampshire, a Republican in politics, by President Cleveland, as an examiner-in chief in the Patent Office. The appointment was based simply on the merit and ability which he had displayed in the previous positions he had held and demonstrated better than anything else could the practical application of civil service principles. During the summer of 1897 he conducted an investigation into abuses of Patent Office practice in a masterly and effective way, displaying judicial ability of a high order.

During the illness of Mr. Butterworth, Judge Greeley had entire charge of affairs, and conducted them with marked ability. With the conduct of the Patent Office in the hands of such men as Mr. Duell, the Commissioner, and Judge Greeley, his assistant, the inventor will know that his interests will be carefully safeguarded.

Acetylene Explosions.

Developments have been somewhat retarded with this new and we must admit excellent illuminant, by the various accidents which have occurred at various times, and under certain conditions. It must be remembered that acetylene is an inflammable hydrocarbon gas, and possesses, by reason of its combustible properties alone, certain properties common to all gases of this series or mixtures of the same. Explosions of illuminating coal gas are common and many of our coal mine disasters are due to the explosion of mine gases; similarly vapors of benzine, dust from mills, factories or coal breakers occasionally inflame and explode under certain conditions. Therefore, the simple fact itself is not an exclusive property of acetylene, but rather that belonging to all combustible material under certain well defined conditions.

The condition referred to is, that sufficient oxygen shall be present and intimately mixed with the gas or finely divided combustible to produce and support combustion after spontaneous or purposive ignition has taken place. Usually this oxygen is supplied by the air; and, therefore, certain definite mixtures of air with various gases are explosive, the latter term indicating that combustion takes place more or less instantly, thereby generating a considerable amount of heat, which, imparted to the gases of combustion, expand instantly and tend to increase in volume to such an extent as to burst the confining vessel or do other serious damage. Thus if we have acetylene confined in a small gas holder such as accompanies some generators, or in the generating vessel itself, it is harmless so long as it is not mixed with air, but as soon as any vent or cover is opened admitting oxygen, the mixture is liable to detonation when an open flame is brought in contact with it. And thus was caused all the explosions of non-liquefied acetylene gas which we have any knowledge of. Carbide is of such good quality that there never will be sufficient phosphorus in the gas to cause spontaneous combustion upon the admission of air to it, and should such a gas be made, it would have such an evil smell that the carbide would be rejected; for the odor of acetylene is due to the phosphureted and sulphureted hydrogen it contains. These impurities exist primarily in the lime and carbon used to make the carbide in the electric furnace.

Let us now take a brief survey of some of the principal accidents that have occurred. In France there have been a number of minor explosions. While brazing a generator which they believed perfectly free from gas, some workmen of Paris were seriously injured, as the vessel was but partially empty and contained the requisite air and gas mixture. At Fecamp a similar accident was caused by a workman soldering a gas holder without taking the trouble to empty it. A café was destroyed at Lyons by a violent explosion due to the carelessness of a boy who had neglected to close a valve on the generator, thus allowing the gas to escape into the room during the night, all ready mixed for ignition by a candle in the morning. At Milan a foolhardy inventor looked for a leak in his apparatus with a lighted candle—and found it, but was dangerously wounded in doing so. While attempting to solder a generator containing a mixture of gas and air, two workmen of Chateauroux were wounded by the resulting explosion. Again, near Toulouse, a tinsmith and his helper were endeavoring to make a generator work, and by their recklessness of consequences caused an explosion which killed both. At Compiegne, in a generator factory, while a generator was being tested, the foreman left the shop for a moment, advising his helper not to approach it with a light. He was scarcely gone before the inquisitive workman lit a candle and approached the apparatus (the bell of which had been removed), and was killed by being struck on the head by a flying fragment. At the restaurant of M. Marignac, at Portet, in Haute-Garonne, the proprietor and another man attempted to clean a generator which had just been installed. He was removing the cover when an explosion occurred, injuring him seriously about the body and legs, while his friend had his right leg maimed.

Another phase of these explosions appears in an explosion at the shop of M. Caron, a bicycle manufacturer of Paris. He sold carbide to supply the acetylene lamps of wheelmen. This carbide was shipped in hermetically sealed tin cans in wood cases, having the top soldered on. While attempting to open this can in the usual way by using a hot soldering iron, he found it was not hot enough and carelessly used the flame of a plumber's lamp instead. The solder melted, but there had been enough moisture in the air inclosed with the carbide to generate some acetylene gas, and this was ignited by the flame of the plumber's lamp. A detonation followed, and M. Caron, who was sitting on the can, was burned about the upper part of his body and his workman was hurt by flying pieces of the can about the head and chest. Although this differs from the other explosions slightly, the cause is the same—applying a flame or incandescent body to a mixture of gas and air. All could have been avoided by ordinary precautions.

In Germany we find similar accidents and in England in less degree. In the United States there are a few examples of note. At Rochester, while working about the safety valve of a galvanized iron gas holder, the experimenter was dangerously injured and a bystander narrowly escaped. It is said that the injured man was bending over the gas holder and was attempting to pull it out, evidently drawing air in at the same time and forming an explosive mixture. The room was dark and a gas jet was burning above the apparatus, the cause of an explosion thus being not difficult to trace. Similarly, at Wilmington, a boy was temporarily left in charge of a generator, and, finding the gas light growing dim, attempted to operate the apparatus. He is supposed to have opened the generator by unscrewing the cover, and to have taken a candle to examine its interior to see where the trouble was. Naturally an explosion followed. It is thus apparent that these accidents were caused by igniting an explosive mixture of acetylene and air, which mixture may contain from 3 to 50 per cent of acetylene, the maximum effect being obtained between 12 and 20 per cent. The range with coal gas is less, beginning at about 8 per cent of gas, and the explosive intensity is not so great.

Acetylene should not be kept under a pressure of more than about 25 pounds per square inch gage pressure, and compressing directly in the generator has been found dangerous, as the temperature generated is liable to cause decomposition; just as acetylene under low pressure has its one great element of danger—explosive mixtures of air and gas—so compressed or liquefied acetylene has its bete noir—temperature.

Liquefied acetylene expands remarkably under the effects of temperature, about one atmosphere (15·4 pounds per square inch) for a rise in temperature of about 2° Fah. Consequently, the heat does not have to be very great to cause the pressure in the storage flask to exceed its strength, and it bursts. The liquid at once expands into gas, and expands still further if it comes in contact with fire, or explodes with tremendous violence, if allowed to mix with air before ignition. New Haven the past year witnessed a very destructive explosion of a flask of liquefied acetylene. The evidence indicated that there was a leak in the valve of the flask caused by a fracture, and that the escaping acetylene was ignited by a match or candle used to test the regulators. The escape of gas was evidently larger than ordinary, causing a large development of flame, which heated the flask up to bursting point, and the shop was demolished by the resulting explosion. At Paris an explosion occurred in the laboratory of Prof. Pictet of a similar cylinder, due to improper handling by an employé.

About a month ago the works of the United States Liquefied Acetylene Company, of Jersey City, were demolished completely by exploding cylinders of liquefied acetylene. Although the coroner's report has not as yet been issued, the evidence seems to point to the fact that a flame was seen in the room before the explosion, apparently coming from a cylinder which had been partly filled with acetylene and blown out again to remove any air that may have been contained. This escaping gas must consequently have been ignited somehow, although the witnesses who could have told how were killed by the explosion. It must be remembered that acetylene gas is readily ignited by a spark, a lighted cigar or pipe, a red hot coal or similar incandescent body, and that carelessness or ignorance of these conditions evidently has caused many accidents. After the first cylinder exploded, the burning gas generated such a high heat that the score of other filled cylinders exploded like a pack of gigantic fire crackers. A boiler was projected through the air to a distance of 200 yards, and earth tremors were felt as far as Staten Island.

These explosions, all of which were more or less disastrous, must one and all be traced to carelessness. A careful man does not go into a cellar in which there is a leaking illuminating gas pipe, carrying a lighted candle; neither does he tumble a can of nitroglycerine off a wagon or throw a lighted cigar into a keg of powder. With the same degree of carefulness, he will not approach a mixture of air and acetylene with a lighted lamp or cigar, nor will he place a flask of liquefied acetylene where any escaping gas will be ignited or the flask itself unduly heated.

A great deal of groundless fear has been induced by the above disasters. As a consequence we still hear about acetylide of copper, although experience and experiment have not corroborated the oft-repeated warnings against it. Similarly phosphureted hydrogen has caused much disquietude, but thus far no harm has been traced to this substance. However, when the carbide is unusually impure, the gas will have a very decided fœtid garlic odor, and the products of combustion, when not permitted to escape, may cause discomfort while breathing it. American carbide is quite free from this defect, and owing to the small consumption of this gas (one-half cubic foot for a twenty-five candle power light as compared with five cubic feet of illuminating coal gas), the formation of vitiated air is slow in comparison. When breathed it is not so poisonous as coal gas. And we may safely state that, if we observe the two necessary precautions of low temperature and keeping an open flame away from the generators and gas holders, this gas is perfectly safe to use.

Therefore, generators should be located in well ventilated places, preferably out of doors, and should be opened for filling and cleaning only by daylight. Liquefied acetylene is scarcely a safe form to use this gas in, as the pressure necessary for liquefaction is at least sixty-eight atmospheres—a pressure that in itself is dangerous and admits of no defective apparatus. Acetone as a solvent has not as yet received sufficient application to judge of its possibilities.

Miscellaneous Notes and Receipts.

Cleaning Lenses.—For cleaning optical lenses the Allgem. I. f. Uhrmacherkunst recommends vegetable pith. For this purpose the medulla of rushes, elders, or sun flowers is cut out, the pieces dried and pasted singly alongside of one another upon a piece of cork, whereby a brush-like apparatus is obtained which is passed over the surface of the lens. For very small lenses pointed pieces of elder pith are employed. To dip dirty and greasy lenses into oil of turpentine or ether and rubbing them with a linen rag, as proposed by the above journal, seems hazardous, because the Canada balsam with which the lenses are cemented for the purpose of achromatizing might become dissolved. One had better carefully wipe off the lenses with a soft linen rag dipped in oil of turpentine, etc.

To Render Fabrics Fireproof.—16 pounds pure ammonium sulphate, 5 pounds pure ammonium carbonate, 6 pounds boracic acid, 4 pounds pure borax, 4 pounds starch or $\frac{4}{5}$ pound dextrine or gelatine, 200 pounds water. Into this liquid the fabrics are dipped at 86° F., so that they are well saturated; then they are wrung out lightly and sufficiently dried for ironing. The quantity of the starch or the dextrine and gelatine may be changed according to the degree of stiffness the stuffs are to possess. One quart of the liquid will impregnate about fifteen square yards of stuff.—Färber Zeitung.

Weatherproof Coating for Diaphanies.—For producing this weatherproof coating proceed as follows: Unite by shaking 100 parts absolute alcohol and 2 to 3 parts of thick turpentine and after the latter has dissolved add about 5 parts of camphor. Now add about 10 parts of pyroxylin which has been moistened with a mixture of 10 parts of glacial acetic acid and methylic alcohol and soaked lightly into the above described solution. The whole is allowed to settle in the warm, whereby the parts of water which are contained in the ready product can separate out. The supernatant liquid is ready for use. A picture provided with this coating is said to be impervious to all influences of the weather and to be able to even withstand slight mechanical actions.

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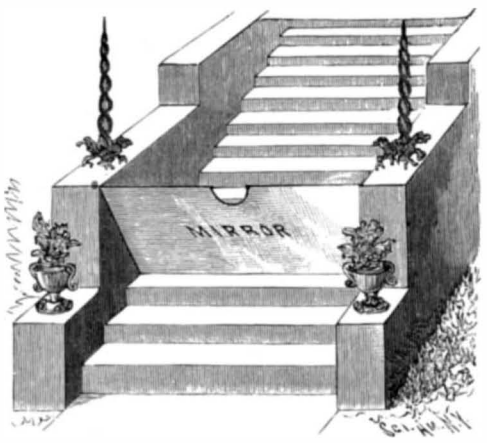
THE SPIDER AND THE FLY.*

This is one of the most interesting of the series of tricks which depend upon mirrors, and of which the "Decapitated Princess" is a type. When the curtain rises, the scene shows a gentleman's country house set upon the embankment and surrounded by grass plots and shrubbery. This is painted scenery such as is usually used in theaters. The house is approached by a set of stone steps which are built out from the scene proper, or, in other words, the drop. These are what is known in theatrical parlance as "practical" steps; that is, they may be ascended. The steps are incased by side walls, and these walls are surmounted



THE ILLUSION EXPLAINED.

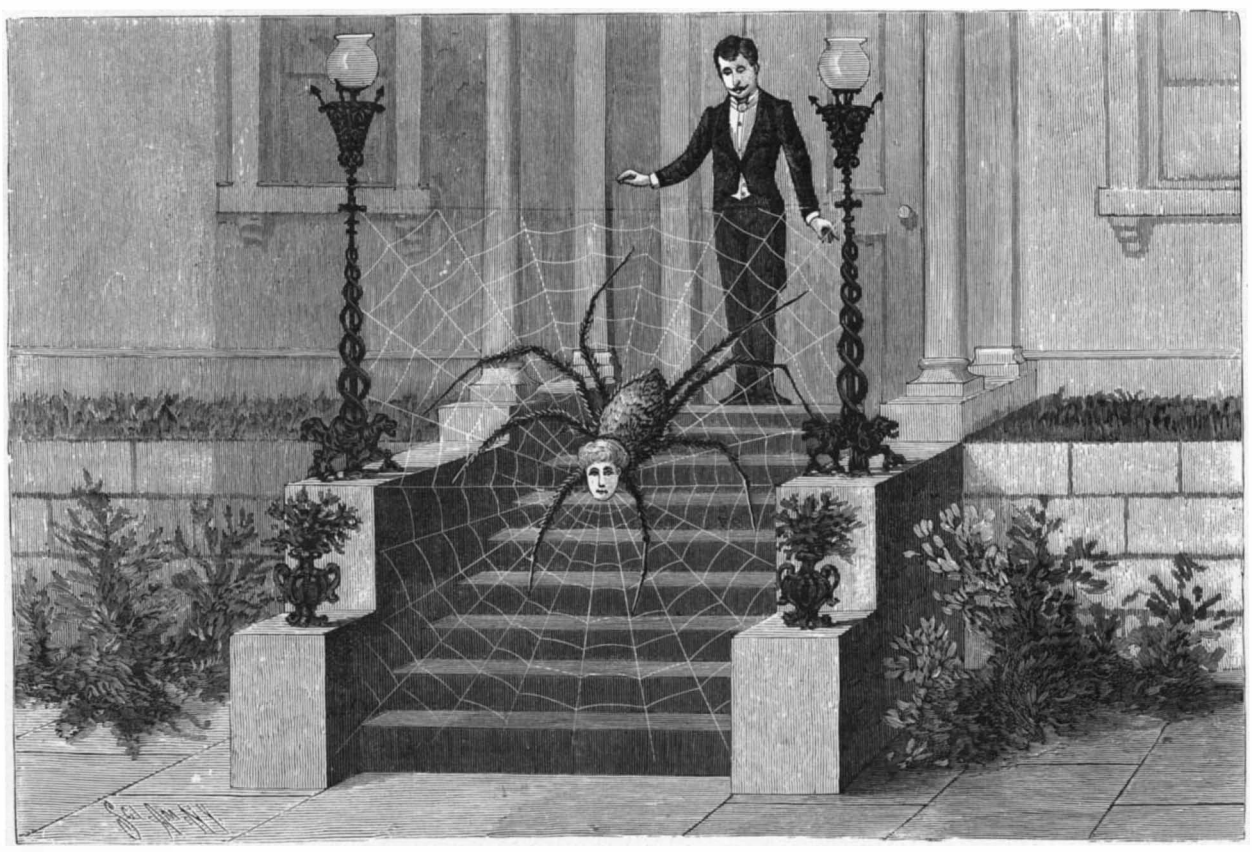
by vases of flowers and handsome lamp posts. The steps lead to the doorway of the house; the door is also "practical," and can be opened and shut. The story runs that the house was deserted for such a long time that the steps were covered by a gigantic spider's web, and the spectator is surprised to see this web, which extends from post to post and to the side walls of the steps.

In the center of this gigantic web is seen a spider's body with a woman's head. The steps leading to the doorway of the house are open, and a person starts to descend, but stops on seeing the spider, and retreats after taking three or four steps down the stairs. This adds greatly to the illusion, as it looks as if it could not be produced by a mirror. You can see both above and below the head, and the steps may be seen at any angle you choose. The puzzling part of the trick is the question of the whereabouts of the lady's body.

Reference to our second and third engravings will give the secret of the trick. The mirror lies at an angle of 45° and runs from the base of the posts to the rear of one of the treads of the lower steps. The mirror extends the full width of the steps. A semicircular hole is cut out of the center of the mirror, at the top edge; this is to receive the lady's head.

The spider's body is fastened to the network of rope; the lady has simply to affix this body to her head, and the illusion is complete, as the body of the lady is concealed behind the glass. The mirror reflects the lower steps, so that this reflection really appears to be a continuation of the steps, and the entire flight seems unbroken. When the person appears at the door and descends the steps, he must be careful not to come below the line of reflection, as his legs will not be visible. The top edge of the glass is concealed by a rope of the web, as it is directly in front of it, and for safety is usually cemented to the glass.

In our diagram, No. 1 represents the steps; 2, the mirror; 3, the web; and 4, the lady. This trick requires the most careful preparation and adjustment, but when this is accomplished, the results are extremely satisfactory.



THE SPIDER AND THE FLY TRICK.

MONT ST. MICHEL, on the Breton coast, is likely to be spoiled from an artistic standpoint, as the department authorities are planning to build a railroad to the mount from Pontorson, the road running over the dike and on the ramparts, and the station being at the foot of the mount.

*Copyrighted, 1897, by Munn & Company. From "Magic: Stage Illusions and Scientific Diversions, including Trick Photography."

Willow Culture in Europe.

Europeans cultivate willow alongside of wheat. France leads, and Germany and Holland stand high in willow culture. In Germany there are 40,000 persons engaged in making willow baskets, and 50,000 acres of land are used in growing the willow for them. The culture of the willow is the simplest thing in the way of cropping. A twig stuck into the moist ground is all that is required. Nature does the rest. For fine basket work Salix amygdalina is the queen of willows, although Salix purpurea and viminalis are also extensively used. In France the willow grower does not hesitate to plant good wheat lands in willow. In regions where lumber is scarce baskets replace cases, boxes and trunks. In the region of La Tremblade and Arcachon there are large plantations of willows and factories for the manufacture of rough baskets in which to ship their famous oysters. It is in the Low Countries the willow is used most. It serves for baskets of all kinds, fences, cattle racks, wagon tops, trunks, boxes, and even the signals along the river are painted willow wickerwork. From its wood they make their indispensable sabots, or wooden shoes. It serves still another purpose; when planted alongside their many dikes, it holds them in place and it constantly catches the sediment, increasing the depth and fertility of the soil. The beneficial effects of willows along the banks of streams and rivers cannot be overestimated. The fertile soils washed down from the farm lands, instead of flowing into the sea, are caught by the willows along the shore. In that way streams are narrowed and consequently deepened. Away up in the mountains in France, where, owing to deforestation, the streams rush with much destructiveness down the steep mountain sides, they wind willow twigs in the shape of a hammock and throw it across the stream. These twigs soon sprout, take hold of the soil and force the stream to move in a zigzag way.

Odor Mixture.

The relation of elementary sensations to the sensation of their compound has given rise to much theoretical discussion. In the senses of sight and hearing it has also been the subject of considerable experimental work. The laws of color mixture have long since been formulated, and the sequence of the color series, like that of the tone series, is well known. In the domain of smell, owing to practical difficulties that attend the investigation, little progress has been made. Certain odors stand marked as qualitatively distinct, but their relations to one another and the arrangement of their "shades" into a single graduated series has never yet been satisfactorily demonstrated. On the other hand, it has been shown that odor mixtures (of many odors, at least) give rise to new and qualitatively simple odors, thus resembling the color mixtures rather than the accords of tone combinations. Zwaardemaker, in a recent work, gives a series of nine distinct classes of odors, into one or the other of which he thinks any particular odor can be placed. He resolves compound odors into elements belonging to two or more of these classes. When the organ of smell is fatigued for one class of odors, the remaining elements in the compound are sensed, and if the compound consists of but two elements, they may readily be distinguished by this means. Both this author and Aronsohn, an earlier writer, speak of certain odors which do not combine to form a mixture, but when placed together give rise to a blended sensation, each element of which may be sensed separately at will. In some compounds, again, one element predominates so strongly that the other is wholly indistinguishable.

Nagel has lately taken up the investigation by a different method—that of simply sensing the various compounds without fatiguing the organ of smell. As a result of his investigations he concludes that odor mixtures without exception follow the law of color mixture. When one element of a compound extinguishes the other, it is because the former is of far greater intensity; but by reducing this intensity sufficiently a

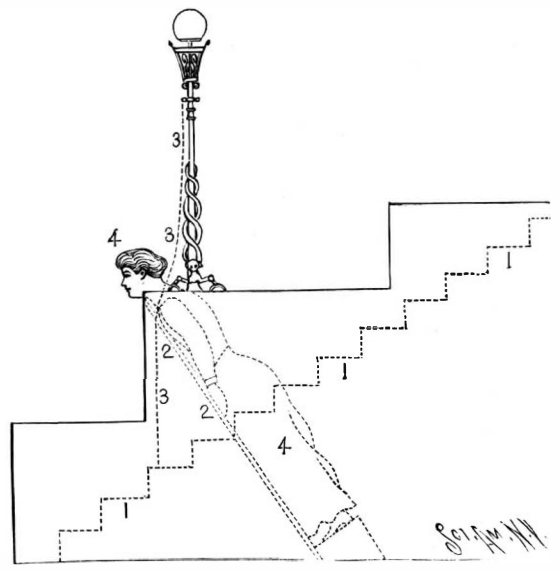


DIAGRAM SHOWING ARRANGEMENT OF MIRROR.

combination is at length reached in which the two unite to form a true mixture. He therefore takes exception to the earlier view, and believes that any two odors can be mixed in such proportions as to produce, at least momentarily, the sensation of a simple odor, of a quality distinct from the components. Whether the new odor is sensed as such permanently, or not, depends on the condition of the sense organ; if the latter is less fatigued for some of the elements than for others, the former will gradually tend to predominate. The true color mixture—that in which none of the elements predominate—"resembles each of its components, without, however, being like them." Thus the principles of odor mixing, according to Dr. Nagel, are similar to those of color mixing; and the correspondence extends, as far as the author's observation goes, to the law of intensity; the intensity of an odor mixture is never stronger than that of its components. The author has found several pairs of odors that are more or less complementary and produce an almost odorless mixture, though he has never succeeded in reaching this limit. As regards the arrangement of simple odors into a series, Dr. Nagel's experiments do not tend to verify the classifications hitherto proposed; but he does not venture upon a classification of his own, since he has been unable to discover any odors which can be regarded as really "elementary."—American Naturalist.

A PROCESS for spraying cloth with dye liquor for producing ornamental effects has been brought forward by W. Grimshaw, a manufacturing chemist of Manchester, England. The arrangement is characterized by entire simplicity, a revolving or reciprocating brush being so adjusted in the machine that a bar catches its bristles or wires momentarily, and when these are released they dash the colors on to the fabric. In practice troughs are employed containing the colors, to each trough being fitted a brush in conjunction with a bar or roller. The fabric or material to be ornamented is so guided as to travel over or in front of the brushes, these being mounted so that their bristles come in contact with the color and carry some of it forward until they momentarily catch against the stationary bar or roller, and as soon as released spray the colors on to the fabric in the form of a colored rain. The fabric may be printed in an ordinary printing machine, either after or before the spraying operation, and with any suitable pattern.

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RECENTLY PATENTED INVENTIONS.

Engineering.

ROTARY ENGINE.—Horace J. McLoed, Louisiana, Mo. This invention provides an engine having high and low pressure cylinders, each containing a piston with radially movable wings, and with steam passages leading fromone to the other. The pistons are carried on hollow shafts, one shaft serving as a steam supply and the other as a steam exhaust, the first piston having passages leading from the steam supply to the periphery of the piston, and also a passage leading to the remaining piston, whereby the latter may be driven by the exhaust steam from the first piston.

HOT WATER AND STEAM BOILER.—Eugene S. Manny, Montreal, Canada. This invention affords a vertical sectional boiler of simple and inexpensive construction, adapted for use as a hot water or steam boiler, and designed to secure a perfect circulation of both heat and water. The water sections are located between the fire pot and dome, and the intermediate and lower sections have central fire openings over the fire pot, with return and offtake openings for the products of combustion at their sides, the crown section being provided only with offtake openings for the products of combustion communicating with those of the lower water sections and with the dome.

Railway Appliances.

CAR COUPLING.—Christopher Dutchburn, Highfield, Canada. According to this invention pins and links used as a coupling are operated by means of rock shafts mounted at the ends of the cars and extending to the sides, obviating the necessity of trainmen passing between the cars. A ledge extends out from one side of the throat of the coupling head, and a plate sliding horizontally through the coupling head supports a pin out of the throat, while a wing pivoted to the outer side of the coupling head is attached to the plate, the ledge overhanging the wing, and a spring pressing the wing to hold the plate inward. A transverse shaft carries cams to lift the links, the pushing of a link into an opposing coupling allowing the pin to drop into engagement therewith.

Electrical.

TELEGRAPHIC SIGNAL.—James Nicolson, Buenos Ayres, Argentina. To simplify telegraphic messages, especially in long distance submarine work, and also to facilitate heliography, and render mistakes less likely in connection with special code words, this inventor has patented a system according to which the vowels and accented vowels are made by an uneven number of elementary motions, or dots and dashes, and the consonants by an even number. The inventor has likewise copyrighted, in this country and England, a code book especially advantageous for transmitting cipher dispatches.

Mining, Etc.

MINING DRILL AND CHANNEL CUTTER.—John P. Paynter, Topeka, Kan. This invention covers an improvement on a former patented invention of the same inventor, providing a new drill and cutter arranged to cut a narrow opening or slot in a seam or underneath the coal, and remove the cuttings from the seam, to enable the miner to easily wedge or break down the coal above. The frame of the device travels on a single track, and is adapted to swing sidewise and up and down with the track as a fulcrum, in combination with an air-operated motor and flexible connections, while the frame carries an outwardly extending cutting arm having radial teeth, behind which is a spoils conveyor.

CATCHING WASTE PRODUCTS FROM LEAD SMELTERS.—John B. Sergeant, Joplin, Mo. Leading from the lead smeltery to the smoke stack, according to this invention, is a special form of trail or conduit in which is introduced a perforated pipe arranged to eject a spray of cold air into the gaseous current through the trail for cooling the gaseous products of the smeltery and causing them to settle and precipitate. The cooling of the fumes and waste products in the manner provided for is designed to condense and throw down all the metallic substances while allowing the gases to escape.

Mechanical.

WRENCH.—Jacob S. Haye and Francis M. Humphrey, Pendleton, Or. This wrench has a tubular shank provided with guideways and with longitudinal spring tongues having teeth or projections at their free ends, while a longitudinally sliding handle section is provided with a shaft having rows of serrations, and so journaled that it may be turned to set the serrations into and out of engagement with the spring tongues, thereby facilitating the adjustment and locking of the sliding jaw in any desired position.

COMBINED WRENCH AND NIPPERS.—John Rosendahl, Delhi, Minn. For use especially in connection with carriages and other vehicles, this tool is made with two levers to swing toward and from each other, and carrying racks which serve to actuate a ratchet wrench, and also have edge portions which form nippers. The two levers are pivoted on a frame in which is mounted a shaft carrying a gear wheel meshing with the rack bar carried by each lever, while a second gear wheel, loose on the shaft, meshes with a ratchet disk fixed to the shaft, there being a revolubly mounted wrench head driven from the second gear.

TOOL HANDLE.—Hugo A. Zeckendorf, Tucson, Arizona Territory. This invention provides a handle designed to be self-locking when placed on the tool, the handle being more firmly locked on the tool, such as hammer or ax, according to the more violent use of the tool. A transverse opening is made from side to side in the eye of the tool, and the handle is made with a tapering slot from its outer end, forming a wedge-shaped socket with larger inner end, in which a wedge is inserted when the handle is placed on the tool, the wedge being secured in place by keys passed through the transverse opening.

PLANE.—John N. Schneider, Mendota, Ill. In hand planes this invention affords a tool in which the bit is automatically retired from its cutting position during the back stroke, a novel mechanism being also provided for the adjustment of the bit, which may be regulated while in use without removing the hands from the handle. The bit stock is pivoted in the plane stock, and the handle is designed by its rotation to regulate the adjustment of the bit stock, and to automatically throw the bit into operative or inoperative positions as the pressure is directed to propel or retract the plane.

LUBRICATOR.—Carl Geier, Oberlangenbielau, Prussia, Germany. To supply a lubricant to machinery in motion, making the supply dependent on the speed of the parts, is the object of this invention, which provides means for regularly supplying the lubricant, and to operate an alarm when the supply in the storage tank has become nearly exhausted. Within a lubricator tank connected by suitable channels with the machinery to be lubricated is a float, the latter being so arranged in connection with a hammer and bell that, as the float nears the bottom of the tank, the hammer will be caused to continuously strike the bell.

Agricultural.

GRAIN LIFTER FOR MOWING MACHINES.—Wilhelm Jager, Kankendorf, Germany. To secure the reliable and uniform operation of the cutters of mowers and harvesters, this invention provides devices to raise the stalks to an approximately upright position, in case they have been bowed down by rain or wind, thus enabling them to be cut as near the ground as possible. On the stubble side of the cutter is a lifting arm extending lengthwise of the machine, and rakes to gather the cut grain are pivotally connected to supports adapted to travel over the arm, chains connecting the free ends of the supports to the rakes to limit the movement of the supports.

Miscellaneous.

INDICATOR FOR OIL WELLS.—Oliver H. Burdett, New Athens, Ohio. For use in weak wells, and more especially for indicating the direction of an oil pool from the well, to enable the operator to drill a second well accurately into the oil source, this invention provides devices to be let into and removed from the first weak well to indicate the direction of flow of the oil. The indicator comprises a perforated casing in which are arranged one or more vanes to be acted on by the flow of the oil, the casing also holding a compass and means for locking the vanes and the needle of the compass in position.

FENCE.—Emil M. Kopka, Adrian, Mich. According to this improvement, while the horizontal or strand wires are securely fastened to the posts or pickets, ample provision is made to allow for the expansion and contraction of the strand wires without damage to the posts. The strand wires are formed with three bends at each post, and a lock made of a single piece of spring wire is bent to form end loops and transverse hooks, the strand wire extending through the loops, around the post and around the hooks, thus allowing the strand wire to readily expand and contract without affecting its fastening to the post.

TRACTION WHEEL.—Adam and John Smith, Blissville, Ill. For traction engines or similar vehicles this invention provides a wheel with mud shoes and a simple means for automatically moving the shoes into position relatively to the rim of the wheel to serve as teeth in mud or soft roads, the shoes being movable into the rim of the wheel while traveling over hard roads or bridges. The shoes are pivoted in recesses extending through the rim of the wheel, rock shafts mounted in frames secured to the spokes of the wheel having connection with the shoes, while holding arms extended from the shoes are adapted to be engaged by tappet fingers to move the shoes in or out.

LIFEBOAT.—Edwin Verburg, Grand Rapids, Mich. The hull of this boat has the usual lifeboat form, with water tanks along its sides and air chambers at the stem and stern, and is provided with a sectional centerboard; but, instead of being propelled by oars, the boat is provided with a screw propeller which rotates in an opening at the rear of the centerboard, the propeller shaft having a universal joint connection with a driving shaft on which is a bevel gear engaging with bevel gears on a countershaft, to propel the boat forward or backward, there being at each side of the trunk a series of connected crank shafts operated by foot pedals similar to those of a bicycle. Provision is made for eight operators, four on each side, and all facing the direction in which the boat is to be propelled.

BOX FORMER.—John C. Titus, Norfolk, Va. This invention covers an improvement in machines for making boxes for holding berries, grapes, etc., providing novel constructions and combinations of parts to permit the proper presentation of opposite end and side portions of the box to the stapling devices. The former is made with a slideway having opposite end bearing portions, and the center is arranged to slide along the center portion and turn in the end portions, the former having a plate with end-bearing portions and a connecting slot, the center turning and sliding in the slot to bring the respective portions of the box in proper position to the staple-setting devices.

CHECK SPRING.—Fred B Walker, San Antonio, Texas. To prevent sudden pulls on a horse's mouth and also to lessen undue tension on the several parts of the harness, this inventor provides a check spring formed of a single piece of wire into a spring coil, one end having an eye for attaching the check rein and the other end an eye for connection with a terret. The end of the terret eye terminates in a loop which extends through the coil and straddles the shank of the rein eye, to limit its outward movement, the return member of the loop having its end extended over the terret eye to form a guard therefor.

CUTTING AND STAMPING CIGARS.—Bernard Sheldon, Brooklyn, N. Y. To print or stamp upon a cigar and cut off its ends, according to this invention, the cutting and stamping mechanism are connected and operate together, the cigar being held firmly on the table by a clamp, but so as not to injure the cigar. The type with which the cigar is stamped extends through an opening in the table, the covering being automatically carried over the opening when the clamp is released, preventing any trimmings from the cigar falling on the stamp.

CORSET CLASP.—William W. Lasker, Brooklyn, N. Y. To facilitate fastening the front meeting edges of corsets, according to this invention, one of the stays is made with beaded lugs and the other with clasp sections comprising pairs of guide plates, movable through which are clasp bars, the plates having slots to receive the heads of the lugs, and the bars being moved automatically when the stays are forced together with the lugs in the slots. The clasp cannot be accidentally released, but facilitates the ready fastening and unfastening of the corset.

POCKET BOOK.—Frederick Hasselberger, Newark, N. J. This pocket book, when opened, has a flat-bottomed compartment, thus rendering coins placed in it more accessible. The side walls are composed of or contain stiffening material, and the lining is so fitted that when the pocket book is opened the bottom portion of the lining rises toward the top to form a broad, level surface.

TEA OR COFFEE POT.—Leonard L. Dick, Boston, Mass. The covers and handles of tea and coffee pots are, according to this invention, made adjustable, to be locked in position when in use, and therefore less liable to breakage than is ordinarily the case. At the side of the pot are vertically arranged lugs with holes therein to receive the top and bottom of the handle, a spring holding the handle in such locking engagement, and on the under side of the cover are spring-pressed bars passing through slots in the cover and adapted to engage a flange in the under side of the top opening of the pot.

STORE OR COUNTER STOOL.—Albert R. Milner, Canton, O. According to this invention, a bracket secured to the base of a counter is provided with an opening in which is pivoted the lower end of a curved arm, to the top of which is attached a stool, adapted to be swung out a suitable distance to afford a comfortable seat in front of the counter, or to be swung inward under the front edge of the counter to be out of the way when not in use, a stop in the bracket limiting the outward movement of the stool arm and a spring holding it turned under the edge of the counter.

CRATE.—John F. East, Norfolk, Va. For the ventilation of berry and other crates, especially those handled in refrigerator cars, this invention provides a ventilated elastic bottom having side bars projecting downward and forming an air space, the bars being recessed or rabbeted to receive the uprights and rails, and the bottom strips being spaced apart corresponding with the spaces between the cups in the crate, while the base bars are seated in the sill bars. The crate is designed to be as strong as the ordinary heavy solid bottom crate.

INVALID'S CHAIR.—Juana G. Yznaga, Brownsville, Texas. This chair has arms projecting forwardly over the seat, pillars resting on the seat supporting the outer portions of the arms, while a table composed of end and top plates is attached to the chair in a manner adapted to support dishes, books or any kind of work. A drawer is also provided for the reception of small articles, and posts extended upward from the table and connected by a cross bar form a rest for books and also a support for skeins of yarn to be wound. A foot rest attachment is readily added or removed.

Designs.

THILL COUPLING PLATE.—Charles T. Redfield, Glenhaven, N. Y. The body section of this plate is curved and has an opening containing a tongue, there being end members at an angle to the body, one of the members being longer than the other and having a reverse curve.

PUZZLE BOX.—Ernest F. Elmberg, Chicago, Ill. This design comprises a rectangular base with a border at its edges, and with partitions of peculiar form and disposition, forming irregular mazes.

COVERS FOR POCKET BOOKS OR CARD CASES.—John Mehl, Jr., Jersey City, N. J. Five design patents in the same line have been issued to this inventor, the first one of which is for depressed or intaglio delineations, forming a diamond panel at the center of the cover, with quadrantal corner panels, and segmental panels and small diamond panels between the corner and the central panels. The second design comprises embossed angular corner panels and groups of radiating depressed or intaglio lines, the lines of each group being converged at different panels. A third design has two embossed corner panels, each with straight outer edges and an inner edge formed with scallops meeting at the center of the panels. Another design has embossed corner panels with straight outer edges at angles to each other and a waved inner edge connecting the outer edges, the waved edge of each panel being decorated with a bead. Still another design has an embossed panel at the end of the cover, the inner edge of the panel having a bead and compound curved lines extending to opposite sides of the cover.

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"A BRIEF FOR THE CIGARETTE."

BY CYRUS ALDRICH.

The paper cigarette, against which so much has been said and written, has an able champion in W. H. Garrison, whose address on the subject before the Medico-Legal Society at its last meeting attracted considerable attention. The current issue of the Medico-Legal Journal contains the full text of this paper, entitled "A Brief for the Cigarette," and in it Mr. Garrison has brought a strong array of facts to shatter, what he termed, the "unreasonable prejudice which at present exists against the paper cigarette," and was certain that the investigations of professional men of science would only emphasize the results at which he had arrived.

The annual output of cigarettes for 1897, he said, was four thousand millions, and if it is the malign and wicked thing which its opponents claim it to be, its manufacture and sale should be suppressed as dangerous to the public health.

Apparently all the agitation against the fragrant cigarette was born in prejudice like that other similar fiction, "chloroforming" or "poisoning from canned meat."

Prof. H. W. Wiley, chief chemist of the United States Department of Agriculture, at Washington, analyzing that brand of American cigarettes which is used by more than one-half the cigarette smokers of the country, finds that a cigarette is made of 1·0926 grains of tobacco enveloped in a wrapper of paper weighing 0·038 grain. In other words, one pound of tobacco will furnish fillers for 416 cigarettes and one pound of cigarette paper will serve to envelop 12,000 of these fillers. One twenty sixth of an ounce of tobacco in a paper one by three inches in size and weighing seven one hundredths of an ounce is a cigarette. Just tobacco and paper!

What kind of tobacco? Prof. Willis G. Tucker, of the Albany Medical College, and analyst of the State Board of Health, says in his ninth annual report:

"Cigarettes are generally made from tobacco of good quality. Sensational statements that they are prepared from the filthiest tobacco and dirtiest refuse are not worthy credence, and can be easily refuted."

Prof. Wiley says that in many samples purchased in the open market he failed to find any trace of arsenic or opium or any of its active principles. Prof. Tucker prepared for his work of analysis by searching the medical text books and journals, and couldn't find even a statement that these foreign substances were employed. Dr. F. G. Payne, State Chemist of Georgia; Profs. Robert and Albert M. Peter, of Lexington, Ky.; Prof. James Dewar, of Cambridge; William Odling, of the University of Oxford; and C. Meymott Tity, of "Forensic Medicine," London Hospital, join with those named in pronouncing the American cigarette free from opium or arsenic.

Then comes the third bugaboo—that of inhalation of the smoke; which called forth an answer from Sir Henry Thompson, who said that the cigarette was the least injurious form of smoking, and Meyer Dutch wrote that "the inhaled smoke rarely passes beyond the bronchi, very little ever entering the air vesicles."

Thus science lays another robust falsehood in the dust. The cigarette smoker may henceforth enjoy his rings of smoke in peace of mind.

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(7331) D. H. A. writes: Please explain the derivation of one volt = 10^8 dynes, one ohm = 10^9 ergs, and one ampere = $\frac{1}{10}$ abs. unit. Now, don't refer me to Hopkins' "Experimental Science" or Thompson's "Dynamo Electric Machinery," as I have both, and they both fail to give an explanation. Don't

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be afraid of giving any calculus or mathematics, as I am a graduate of the course in civil engineering of Cornell University. A. Your inquiry regarding the value of the volt, ohm and ampere in C. G. S. units does not come within the scope of either of the valuable practical works you name, viz., Hopkins' "Experimental Science" or Thompson's "Dynamo Machinery." As well go to a cook book for the theory of digestion. The C. E. course in Cornell gives the answer to your question in second term, Sophomore year. You might have learned it then. Both our time and space are too valuable to give elementary instruction in the theory of electricity. We refer you to "The Elements of Physics," by Prof. Edward L. Nichols, of Cornell, Vol. 2, "Electricity and Magnetism," price $1.50; "Absolute Measurements in Electricity and Magnetism," Gray; larger edition in 2 vols., price $9.50. "Treatise on Electricity and Magnetism," J. Clerk Maxwell; 2 vols.; price $8. This should be read with "Notes on Recent Researches in Electricity and Magnetism," by J. J. Thompson; price $4.50; as this last is a sequel to Prof. Maxwell's book. We may point out the fact that your statement of the question is not correct. The volt is not equal to any number of dynes; but 1 volt = 10^8 absolute units of difference of potential, or E. M. F., and 1 absolute unit of difference of potential exists between two points when it requires 1 erg of work to bring 1 unit of + electricity from one point to the other against the electric force. You make a similar error of statement regarding the ohm. Your definition of 1 ampere is correct, since

$$1 \text{ ampere} = \frac{1 \text{ volt}}{1 \text{ ohm}} = \frac{10^8}{10^9} = \frac{1}{10} = 10^{-1}.$$

The books named above give, as you request, the mathematical treatment of the subject, and are the best to be had in English.

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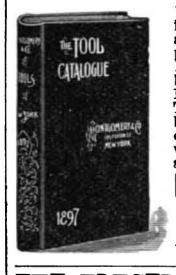

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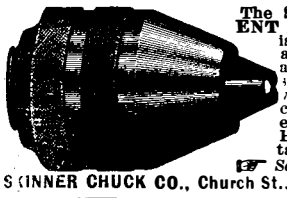

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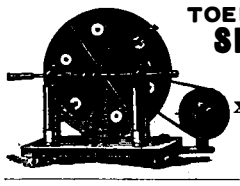

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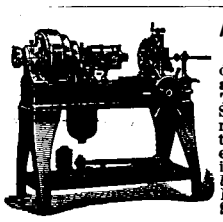

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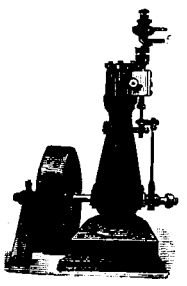

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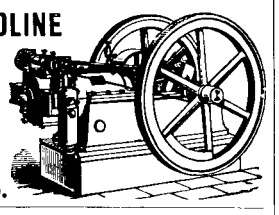

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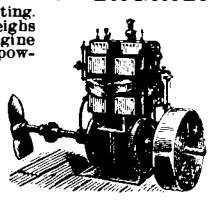

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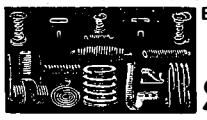

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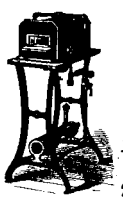

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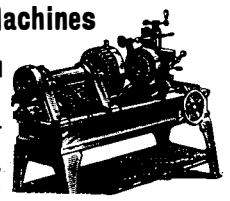

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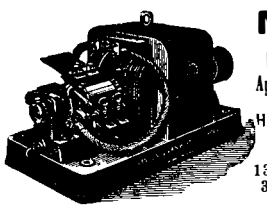

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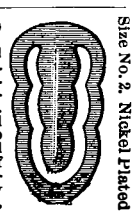

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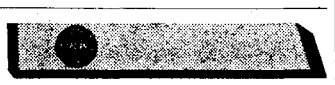

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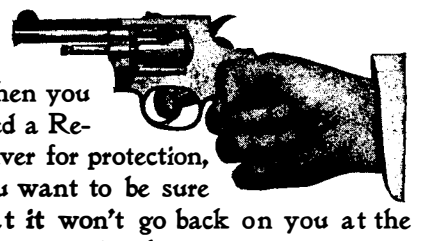

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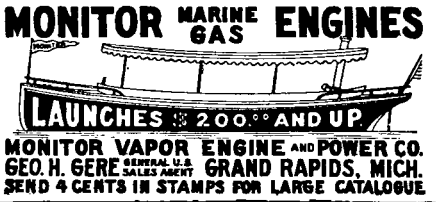

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